STAR

Scientific and Technical Aerospace Reports

SEMIMONTHLY ABSTRACT JOURNAL

JUNE 23, 1967

VOLUME 5 • NUMBER 12

N67-23481—N67-25080

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

PURCHASE OF *STAR*

The semimonthly issues and the cumulative index issues are available postpaid on subscription and in single copy from the Superintendent of Documents, United States Government Printing Office, Washington, D.C., 20402, United States of America.

Semimonthly issues . . .

Annual subscription rate: $33.00, domestic; $42.00, foreign. Price per single copy: $2.25, domestic; 25¢ extra for foreign mailing.

Cumulative index issues . . .

Annual subscription rate: $30.00, domestic; $35.00, foreign. Price per single copy varies according to the number of pages.

Domestic subscription rates . . .

Apply to the United States, Canada, Mexico, and all Central and South American countries, except as noted below.

Foreign subscription rates . . .

Apply to Argentina, Brazil, British and French Guiana, Surinam, British Honduras, and all other countries throughout the world.

Payment should be by check, money order, or document coupons, and must accompany order. Remittances from foreign countries should be made by international money order, or draft on an American bank, payable to the Superintendent of Documents, or by UNESCO book coupons.

PUBLISHED BY:
UNITED STATES GOVERNMENT
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
SCIENTIFIC AND TECHNICAL INFORMATION DIVISION

Scientific and Technical Aerospace Reports, Volume 5, is prepared by the NASA Scientific and Technical Information Facility operated for the National Aeronautics and Space Administration by Documentation Incorporated.

Use of funds for printing this publication approved by the Director of the Bureau of the Budget June 7, 1966.

Introduction

WHAT *STAR* IS

Scientific and Technical Aerospace Reports (STAR) is a comprehensive abstracting and indexing journal covering worldwide report literature on the science and technology of space and aeronautics. It is published twice each month.

Major areas covered in *STAR* are:

Scientific and technical reports of the National Aeronautics and Space Administration and its contractors; scientific and technical reports of government agencies, universities, and research organizations throughout the world.

HOW *STAR* IS ORGANIZED

The first section of *STAR*, arranged in 34 categories, contains abstracts and bibliographic citations. A second section consists of five indexes: subject, author, source, report/accession number, and accession/report number. Separate cumulative indexes are published quarterly, the fourth quarterly being an annual index for the calendar year. Cumulative indexes also contain a contract number index.

HOW TO USE *STAR*

Readers are encouraged to examine the abstracts in each category of interest. If time is short, and when interest is concentrated in specific areas, readers may wish instead to scan source, author, and subject indexes. A more thorough coverage of a subject field may often be achieved by detailed examination of the subject listings, especially as they are cross-indexed in the quarterly indexes.

AVAILABILITY OF *STAR* AND DOCUMENTS

NASA documents (identified by an asterisk), as well as *STAR* itself, are available without charge to:

1. NASA Offices, Centers, contractors, subcontractors, grantees, and consultants.
2. Other U.S. Government agencies and their contractors.
3. Libraries in the United States that maintain collections of NASA documents for public reference.
4. Other organizations in the United States having a need for NASA documents in work related to the aerospace program.
5. Foreign government or academic (university) organizations that have established reciprocal arrangements for the exchange of publications with NASA, that have current agreements for scientific and technical cooperative activities with NASA, or that have arrangements with NASA to maintain collections of NASA documents for public use.

Department of Defense documents (identified by the "AD" number in the citation) are available without charge to U.S. Government-sponsored research and development activities from the Defense Documentation Center (DDC), Cameron Station, Alexandria, Virginia 22314. Department of Defense documents are not available from NASA.

Other non-NASA documents are provided by NASA without charge only to NASA Offices, Centers, contractors, subcontractors, grantees, and consultants. Foreign non-copyrighted documents will be provided to U.S. Government Agencies and their contractors. AGARD reports that are not commercially available will be made available on the same basis as NASA documents.

Documents that have been placed on microfiche are identified with the symbol #. Microfiche are available on the same basis as hard-copy.

HOW TO REQUEST LISTED DOCUMENTS

If you are registered with NASA, send a completed *Document Request* (Facility Form 492) to:

NASA Scientific and Technical Information Facility
P. O. Box 33
College Park, Maryland 20740

If you are not registered with NASA, but are eligible to receive documents without charge according to the information on the previous page in the section on Availability of *STAR* and Documents, request Registration Form—Technical Publications (Facility Form 713) from the above address.

HOW THE PUBLIC MAY OBTAIN LISTED DOCUMENTS

For reference purposes, NASA documents listed in *STAR* may be consulted at one of the organizations listed on the inside back cover. Commercial publications listed in *STAR* may be consulted in libraries or purchased from publishers or booksellers.

The public may purchase NASA documents and non-copyrighted foreign documents listed in *STAR* from either of two sales agencies, specifically identified in the abstract section:

Clearinghouse for Federal Scientific and Technical Information
(CFSTI)
Springfield, Virginia 22151

Superintendent of Documents, U. S. Government Printing Office
(GPO)
Washington, D. C. 20402

Documents available from CFSTI are sold in hard copy and microfiche form. If a printed hard copy is not available, a facsimile copy is provided. The symbols "HC" and "MF" are used in the abstract section to designate the copy available: "HC" (hard copy) for full size or facsimile; "MF" for microfiche. A unit price policy has been established by CFSTI: $3.00 for printed hard copy or facsimile copy; $0.65 for microfiche.

Not all NASA documents, however, are subject to this policy. Documents available from Superintendent of Documents which are also available from CFSTI are sold at the Superintendent of Documents price, and other selected NASA publications will continue to be priced according to previous practices. In all cases, the *STAR* citation includes the specific sale price which applies.

Following the availability information in the citation of each NASA-supported document is a code, e.g., CSCL 25A, indicating the subject category assigned to that document from the *COSATI Subject Category List* (first ed., December, 1964) published by the Committee on Scientific and Technical Information of the Federal Council for Science and Technology.

The public may request non-NASA documents by writing to the source or other information systems. Identification other than the NASA accession number (i.e., N67-12345) should always be provided when requesting such a document from its source.

ABSTRACTS OF JOURNAL ARTICLES

By arrangement between NASA and the American Institute of Aeronautics and Astronautics, the AIAA publication *International Aerospace Abstracts* is issued in coordination with *STAR*. Each journal appears on alternate weeks. *IAA* uses subject categories identical with those in *STAR*, and publishes similar indexes. *IAA's* worldwide coverage of books and scientific and trade journals complements *STAR's* worldwide report coverage. The two publications thus provide comprehensive access to current literature on aerospace science and technology.

Organizations having a NASA contract may obtain *IAA* by writing NASA, Code USS-A Washington, D. C. 20546. Others should direct inquiries to the American Institute of Aeronautics and Astronautics, 750 Third Avenue, New York, N. Y. 10017.

01 A

02 A

03 A

04 BI

05 BI

06 CH

07 CO

08 CO

Volume 5 Number 12 / June 23, 1967

TABLE OF CONTENTS

Subject Categories

Abstracts in the journal are grouped under the following categories: ***page:***

01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbomachinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion. **2009**

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics. **2012**

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems. **2017**

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology. **2020**

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences. **2030**

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants. **2037**

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation. **2050**

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics. **2058**

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation. **2063**

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories. **2067**

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations. **2073**

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion. **2084**

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences. **2091**

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras. **2097**

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, reliability; drafting; and materials fabrication, handling, and inspection. **2104**

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid-State. **2111**

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see : 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics. **2113**

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics. **2122**

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers. **2127**

20 METEOROLOGY
Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences. 2132

21 NAVIGATION
Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications. 2140

22 NUCLEAR ENGINEERING
Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems. 2144

23 PHYSICS, GENERAL
Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics, 20 Meteorology, and 29 Space Radiation. 2162

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR
Includes atomic, molecular and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation. 2157

25 PHYSICS, PLASMA
Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems. 2176

26 PHYSICS, SOLID-STATE
Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics. 2188

27 PROPELLANTS
Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems. 2195

28 PROPULSION SYSTEMS
Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants. 2199

29 SPACE RADIATION
Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear. 2200

30 SPACE SCIENCES
Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles. 2207

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics. **2213**

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic. **2219**

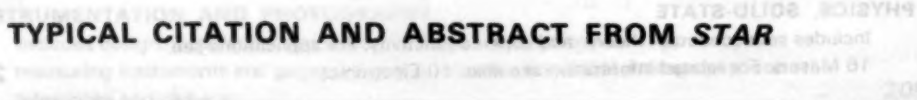
33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants. **2233**

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents. **2239**

TYPICAL CITATION AND ABSTRACT FROM *STAR*



N67-16250*# Solar, San Diego, Calif.

STRUCTURAL AND MECHANICAL EFFECTS OF INTERSTITIAL SINKS

Mark J. Klein and A. G. Metcalfe Jan. 1967 43 p refs

(Contract NAS7-469)

(NASA-CR-81140; RDR-1534-2) CFSTI: HC $3.00/MF $0.65

CSCL 11F

The effect of the purity and thickness of titanium interstitial sink on the residual concentrations of interstitials in columbium was considered from a thermodynamic viewpoint. It was concluded that the equilibrium concentrations of interstitials in columbium is not a sensitive function of these parameters. The structure and hardness of Ti/D-43 diffusion couples were correlated with the partitions of interstitials between the two metals. A reduction in the oxygen and carbon concentration in the D-43 correlates with an increase in the grain size and a change in the grain morphology of this alloy. The equilibrium partition of interstitials between the titanium and the D-43 is believed to account for an increase in the hardness of the titanium, but this partition does not seem to affect the hardness of the D-43. Author

VOLUME 5 NUMBER 12 / JUNE 23, 1967

Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N67-23632# New York Univ., N. Y. Dept. of Aeronautics and Astronautics.

EFFECTS OF NOSE BLUNTNESS ON THE BOUNDARY LAYER CHARACTERISTICS OF CONICAL BODIES AT HYPERSONIC SPEEDS

Nicholas R. Rotta Nov. 1966 43 p refs

(Contract Nonr-285(63))

(NYU-AA-66-66; AD-645668) CFSTI: HC $3.00/MF $0.65

The effect of nose blunting on the boundary layer characteristics over the conical part of a body is investigated. The boundary layer parameters are found as functions of the similarity parameter, and the boundary layer equations are integrated numerically. The resulting profiles are general, being independent of unit freestream Reynolds number and nose radius. The effect of bluntness on transition is investigated. Using the variation of Reynolds number based on the momentum thickness in the swallowing region as an indicator, the type of transition likely to occur, i.e., blunt body or conical transition, is examined. The range of unit freestream Reynolds number for which conical transition will occur is identified specifically for the family of blunted conical bodies of 8 degrees half angle at Mach 10. Based on the transition data, the heat transfer is calculated for regions of the swallowing process for which the boundary layer is laminar. The results indicate a reduction of heat transfer is associated with nose bluntness and can be significant downstream of the nose region if the body nose radius is chosen to make the swallowing distance approximately twice that of the body surface length.

Author (TAB)

N67-23714*# Lockheed Missiles and Space Co., Huntsville, Ala.

AERODYNAMIC CHARACTERISTICS FOR CONE-CYLINDER-FRUSTUM-CYLINDER CONFIGURATIONS AT MACH NUMBERS FROM 0.7 TO 1.96. VOLUME I: LINEAR LOAD DISTRIBUTIONS

J. F. Thompson Washington, NASA, Apr. 1967 157 p refs

(Contract NAS8-20121)

(NASA-CR-737) CFSTI: HC $3.00/MF $0.65 CSCL 01A

The data from an extensive wind tunnel pressure distribution test program were analyzed to provide linear aerodynamic load distributions in the high subsonic, transonic and low supersonic Mach number regimes for cone-cylinder-frustum-cylinder configurations. The configurations were of such geometry as to be compatible with the previous cone-cylinder research which together provide a knowledge of the loads on selected cone-cylinder-frustum-cylinder configurations. The geometrical parameters varied in this study were (1) the cone semivertex angles (from 15° to 40°); (2) the conical frustum angles (from 7.5° to 20°); (3) cylinder diameter ratios (D_2/D_4=0.4, 0.6, 0.8); and (4) the forward cylinder lengths (from 0.5 to 4.0 calibers). The aft cylinder lengths were constant at 3.5 calibers. A comprehensive set of design curves is presented which will enable the designer to determine aerodynamic loads in a Mach number range where adequate information has not been available. Local normal force slope distributions for the segments of a cone-cylinder-frustum-cylinder were developed on a parametric basis for the area of interest. The local normal force slope distributions for the nose cone have been determined in the previous cone-cylinder study and are not presented here. The loads presented here are the distributed loads on the other three sections of the cone-cylinder-frustum-cylinder configuration: forward cylinder, frustum and aft cylinder.

Author

N67-23793*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

AERODYNAMIC DATA ON LARGE SEMISPAN TILTING WING WITH 0.5-DIAMETER CHORD, SINGLE-SLOTTED FLAP, AND SINGLE PROPELLER 0.19 CHORD BELOW WING

Marvin P. Fink Washington, NASA, Apr. 1967 218 p refs

(NASA-TN-D-3884) CFSTI: HC $3.00/MF $0.65 CSCL 01A

An investigation was made in the full-scale tunnel to determine the longitudinal aerodynamic characteristics of a large-scale semispan V/STOL tilt-wing configuration with a single propeller which was tested for both modes of rotation. The model had a half-fuselage on which loads were measured separately. The wing had a chord-to-propeller diameter ratio of 0.5, a 40-percent-chord single-slotted flap, an aspect ratio of 4.88 (2.44 for the semispan), a taper ratio of 1.0, and an NACA 4415 airfoil section. The data were examined to observe the predominant trends. It was found that the direction of propeller rotation had a very significant effect on the lift and descent capability (as determined from drag-lift ratios attainable without stalling of any part of the wing within the propeller slipstream), and that up-at-the-tip rotation gave the more favorable results. The use of a trailing-edge flap was also very effective in increasing the descent capability. For the most favorable combination of the configuration variables, descent angles of nearly 29° were achieved over the entire test range of power conditions.

Author

N67-23800*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECTS OF REYNOLDS NUMBER FLOW INCIDENCE ON THE FORCE CHARACTERISTICS OF A FAMILY OF FLAT-FRONT CYLINDERS
Vernard E. Lockwood Washington, NASA, May 1967 43 p refs
(NASA-TN-D-3932) CFSTI: HC$3.00/MF$0.65 CSCL 01A

The cross-flow characteristics of three flat-front two-dimensional cylinders have been determined for a range of Reynolds numbers from 0.12×10^6 to 1.60×10^6. The data showed a large effect of Reynolds number, flow incidence, and cylinder breadth on the cross-flow characteristics. As the Reynolds number was increased from 0.12×10^6, all three cylinders were characterized by sudden increases in the side-force coefficient which resulted in positive values for an incidence-angle range from about 5° to 120°. A comparison of these data with the data from previous investigations indicated that the range of Reynolds numbers over which the large positive values of the side force existed were dependent on cylinder breadth, with the broader cylinder having the larger range of positive side forces. Author

N67-24031 Aeronautical Research Council (Gt. Brit.)
SOME EXPLORATORY TESTS ON A TWO-DIMENSIONAL BLOWN-CYLINDER MODEL IN THE R.A.E. 2 ft × 1 1/2 ft TRANSONIC WIND TUNNEL
A. F. Jones and W. R. Buckingham London, HMSO, 1967 37 p refs Supersedes RAE-TR-64090; ARC-26850
(ARC-CP-889; RAE-TR-64090; ARC-26850) HMSO: 7s

Static pressure measurements have been made at subsonic Mach numbers to examine compressibility effects on a two-dimensional circular cylinder with two tangential blowing slots. These results together with forces derived from them are briefly discussed. Author

N67-24319*# National Aeronautics and Space Administration, Washington, D. C.
THE CAMBER DISTRIBUTION OF A SPANWISE UNIFORMLY LOADED SUBSONIC WING
Toshio Kawasaki and Masao Ebihara Mar. 1967 23 p refs Transl. into ENGLISH from the Japanese
(NASA-TT-F-10781; TR-104) CFSTI: HC $3.00/MF $0.65 CSCL 01A

Presented is an analysis of the shape of three-dimensional wings in subsonic flow, with a load distribution uniform in spanwise- and arbitrary in chordwise-direction. The considered outline of the wing possesses straight-line leading and trailing edges with a possible taper. Formulas derived from linearized theory are given, with which one can obtain the camber shape from predetermined load distribution. In addition, an expression for calculating the Mach number distribution normal to the isobars on the wing surface is presented. Some numerical examples show that the advent of the critical stage on the wing surface will be delayed up to a considerably high free-stream Mach number by designing the camber shape for the wing in such a manner that it possesses spanwise uniform loading with a chordwise shape suitable for the distribution. Author

N67-24366# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
NUMERICAL ANALYSIS OF THE BLUNT-TRAILING-EDGE SUPERSONIC COMPRESSOR
Stavros Olympios Sep. 1966 66 p refs
(ARL-66-0189; AD-647761) CFSTI: HC$3.00/MF$0.65

The report gives a detailed description of the IBM FORTRAN Program developed for prediction of the quasi-three-dimensional performance of blunt-trailing-edge supersonic rotor. The radial equilibrium equation is solved in the trailing-edge plane and after the abrupt area increase downstream of the rotor trailing edges. Two sample calculations are given: one to illustrate a typical flow condition and one to illustrate the conditions existing when the blade passage is choked. Included also is a listing of the FORTRAN Program. Author (TAB)

N67-24414# RAND Corp., Santa Monica, Calif.
STAGNATION REGION GAS INJECTION IN LOW REYNOLDS NUMBER HYPERSONIC FLOW
S. Y. Chen, J. Baron, and R. Mobley Feb. 1967 45 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(RM-5273-PR; AD-647769) CFSTI: HC$3.00/MF$0.65

The analysis extends Cheng's theory of the hypersonic, thin, viscous shock layer to include effects of foreign gas injection. It is found that the effectiveness of mass transfer in reducing stagnation region heating rates and skin friction increases with an increasing hypersonic viscous similarity parameter, k squared, for a given injection parameter B. In general, the lighter injectant gas is more effective than the heavier injectant gas in reducing both skin friction and heat transfer. The values of the blow-off point for zero skin friction occur at approximately kB = 0.5 and 0.385 for helium and hydrogen, respectively. The lighter injectant gas also tends to thicken the shock layer for a given magnitude of the injection parameter, B, but such effects diminish for high values of k squared and appear to approach an asymptotic limit for a given gas at a given injectant parameter B as k squared approaches infinity. For sufficiently low Reynolds numbers, the effects of mass transfer on both heat transfer and skin friction disappear. For helium and hydrogen injections, it appears that a simple correction of the molecular weight ratio raised to a constant exponent of 1/2 gives a reasonable correlation with air-to-air injection at the stagnation point. Author (TAB)

N67-24475*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ANALYTICAL STUDIES OF ASPECT RATIO AND CURVATURE VARIATIONS FOR AXIAL-FLOW–COMPRESSOR-INLET STAGES UNDER HIGH LOADING
Ronald J. Steinke and James E. Crouse Washington, NASA, May 1967 47 p refs
(NASA-TN-D-3959) CFSTI: HC$3.00/MF$0.65 CSCL 10A

An analytical study of the performance changes of axial-flow compressors with increased aspect ratio and loading was made. The computer program calculations included the streamline curvature and the radial gradient of the combined profile and shock losses in the radial equation of motion. Compressor-inlet stages with aspect ratios of 3.0 to 6.0 for the case of zero tip curvature and with aspect ratios of 3.0 to 9.0 for the case of high tip curvature were investigated. For an aspect ratio of 8.0, calculations were also carried out at a reduced tip curvature and at a reduced loading. Generally, the studies indicate that, with a proper choice of compressor passage geometry, curvature effects could be employed to control high-pressure-loss gradients to some extent and to reduce the possibility of tip-region stalling. Specifically, comparisons of the results of the zero-tip-curvature case with the high-tip curvature case showed that tip-curvature effects reduced tip-region rotor-inlet Mach numbers and permitted a significant increase in aspect ratio while maintaining subsonic meridional velocities. Also, tip curvature caused rotor diffusion factors to decrease at the blade ends. Although substantial flow redistributions occur at high aspect ratios because of curvature effects, the studies indicate no basic limit on aspect ratio for acceptable design point performance. Author

N67-24546*# Northrop Corp., Hawthorne, Calif. Norair Div.
ROTATIONAL APPARENT MASS BY ELECTRICAL ANALOGY

Maurice S. Cahn, J. R. Garcia, and G. M. Andrew 8 Dec. 1966 20 p refs
(Contract NAS2-2671)
(NASA-CR-73080; NOR-66-364) CFSTI: HC $3.00/MF $0.65 CSCL 01A

An investigation was conducted to study methods for the determination of rotational apparent masses by electrical analogy techniques. The change in resistance in a $W=Z^2$ flow field due to the presence of a body was found to work for a certain class of shapes. A method of measuring the summation of the resistance changes between four points was found to work for a larger class of shapes. Author

N67-24613*# National Aeronautics and Space Administration, Washington, D.C.
VISCOUS HYPERSONIC FLOW PAST A SLENDER CONE [OBTEKANIYE TONKOGO KONUSA VYAZKIM GIPERZVU KOVYM POTOKOM]
V. S. Nikolayev May 1967 11 p refs Transl. into ENGLISH from Inzh. Zh. (Moscow), v. 2, no. 3, 1962 p 9–13
(NASA-TT-F-485) CFSTI: HC $3.00/MF $0.65 CSCL 01A

The hypersonic flow of a perfect gas at zero angle of attack past a slender cone is calculated, allowing for the transverse curvature of the surface and the interaction of the boundary layer with the shock wave. The integral relations of impulse and energy are utilized in calculating the boundary layer, assuming the profile of the longitudinal component of velocity as linear and the temperature profile as quadratic (but not similar over the length). The pressure on the external boundary of the boundary layer is determined by the Newton method, allowing for the thickness of the displaced boundary layer. The surface temperature is assumed constant (absolutely heat-conducting body). Author

N67-24626*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL INVESTIGATION OF BASE FLOW FIELD AT HIGH ALTITUDES FOR CONFIGURATIONS OF FOUR AND FIVE CLUSTERED NOZZLES
R. A. Wasko and T. L. Cover Washington, NASA, May 1967 36 p refs
(NASA-TM-X-1371) CFSTI: HC $3.00/MF $0.65 CSCL 01A

Measurements of flow field Mach number with translating probes indicated that in the center of the extended four nozzle clusters, the reverse flow Mach number increased in magnitude with increasing nozzle–pressure ratio (i.e., nozzle-exit to ambient static pressure ratio) for both conical and contoured nozzles. Values ranged from completely subsonic flow for low pressure ratios to almost completely supersonic flow for high pressure ratios. The magnitude of the flow field Mach number for the five nozzle cluster was less than that of the four nozzle cluster. The flow field total pressure for the four nozzle cluster configuration decreased towards the base in contrast to previous assumptions of a constant total pressure in the reverse flow. The magnitude of this loss in total pressure increased with increases in nozzle–pressure ratio. The five nozzle configuration had lower base pressures than the four nozzle configurations at a given altitude and nozzle–pressure ratio, and choking occurred at a higher nozzle–pressure ratio. Author

N67-24843# Celestial Research Corp., South Pasadena, Calif.
EXPERIMENTAL INVESTIGATION OF THE DENSITY FLOW FIELD IN THE STAGNATION REGION OF A BLUNT BODY IN HIGH SPEED RAREFIED FLOW
J. B. Wainwright Nov. 1966 72 p refs
(Contract NOw-0224-c)
(BD-339-101; AD-646743) CFSTI: HC $3.00/MF $0.65

The evolution of shock structure in the stagnation region of spheres was experimentally investigated in air and nitrogen flows at normal Mach number 6 and a Reynolds number range, based on sphere radius and viscosity behind a shock, between 1.7 and 69. The electron beam fluorescence technique was used to measure density in the region between the surface and one radius away from the surface and at angular displacements up to 40 degrees from the stagnation line. Model wall temperatures were held at adiabatic and .28 of adiabatic. Results at the lowest Reynolds number show agreement with free molecule theory when modified to account for single collisions between free stream molecules and those emitted from the model. As density is increased a progressively longer mean free path than that calculated for the free stream and emitted molecules is required to correlate the data. At Re sub s of 20 a shock structure begins to appear but is completely merged with the body influence. The maximum slope thickness of the primitive shock, relative to the mean free path behind the fully developed shock, ranges from 70% to 92% of the fully developed shock thickness for $12 < Re\ sub\ s < 69$. Author (TAB)

N67-24922# RAND Corp., Santa Monica, Calif.
A SNOWPLOW MODEL OF HYPERSONIC UNSTEADY FLOWS
J. Aroesty, A. F. Charwat, S. Y. Chen, and J. D. Cole Feb. 1967 20 p refs Presented at the 40th Jubilee Anniv. of Prof. R. Szewalski in Sci. Res., Gdansk, Poland, Mar. 1967
(P-3521; AD-647287) CFSTI: HC $3.00/MF $0.65

The pressure on a slender linearly accelerating airfoil or body of revolution traveling at high speed is estimated by using snowplow theory in a plane transverse to the direction of motion. The theory is valid for rapid accelerations and provides a quantitative estimate of the effect of acceleration on the air forces. The significant parameter measuring the effect is shown to be a Froude number, Fr = (body length) (acceleration)/(speed) squared. The results from this analysis show that only in extreme cases does linear acceleration or deceleration exert an important effect on air forces. For example, a 50-ft body accelerating 1000 g at Mach 4 has approximately 10 per cent larger wave resistance than in steady flight. The theory is extended to unsteady forces acting on two-dimensional oscillating airfoils. A pressure formula which is valid for linear and nonlinear oscillations is obtained, and comparisons are made with the exact, linearized gasdynamic theory for a hypersonic slender wedge. These comparisons indicate that Newtonian theory is qualitatively correct but quantitatively not very accurate for the calculation of unsteady stability derivatives. Author (TAB)

N67-24958# Army Aviation Materiel Labs., Fort Eustis, Va.
DRAG MEASUREMENTS IN A STREAM WITH SINUSOIDALLY FLUCTUATING VELOCITY IN THE LONGITUDINAL DIRECTION
Clifton G. Wrestler, Jr. Nov. 1966 34 p refs
(USAAVLABS-TR-66-89; AD-646643) CFSTI: HC $3.00/MF $0.65

The drag coefficients of cylinders and plates in a stream with sinusoidal fluctuations in velocity are investigated. A tube with counterrotating vanes at the rear is used to produce the flow fluctuations. This tube was placed in the open jet of a low speed tunnel. The models were mounted on a vertical sting, which supported the one-component force transducer. The drag coefficients, based on average values of drag and dynamic pressure, show no variation with frequency parameter changes. The fluctuating component of drag does show a dependence on the frequency parameter. Also, a phase shift is noticed between the velocity and the force. Author (TAB)

N67-24985# ARA, Inc., West Covina, Calif.
HYPERSONIC FLOW OF BLUNT DELTA WINGS AT LOW ANGLES OF ATTACK. I: SHOCK WAVE SHAPE AND SURFACE PRESSURE DISTRIBUTION
Bernard Mazelsky, M. Liu et al Nov. 1966 62 p refs
(Contract AF 49(638)-1309)
(ARA-81; AFOSR-67-0005; AD-646865) CFSTI: HC $3.00/MF $0.65

This report covers a portion of a research program on the aerodynamic characteristics of a cylindrical-leading-edge 70 degrees swept delta wing at high supersonic and moderate hypersonic Mach numbers, and for small values of angle of attack. Prior to the calculation of the lift and drag characteristics of the wing, a semi-empirical method was developed to predict the shock wave shape surrounding the wing as well as the corresponding pressure distribution on the wing surface. The theoretical shock shape and pressure distribution results are compared with experiments available from the open literature as well as with experimental pressure distributions obtained in the present program on the tip portion of a blunt 70 degrees swept delta wing. Within the range of applicability of the semi-empirical method, the predicted shock wave shapes are in good agreement with experiment. The calculated pressure distributions agree quite well with experiment, provided the angle of attack is below 15 degrees and the Mach number is above M = 3.0. TAB

N67-25019*# National Aeronautics and Space Administration, Washington, D. C.
EXPERIMENTAL STUDY OF SINGLE-DEGREE OF FREEDOM FLUTTER IN TRANSONIC FLOW [ETUDE EXPERIMENTALE DES FLOTTEMENTS A UN DEGRE DE LIBERTE EN ECOULEMENT TRANSSONIQUE]
H. Loiseau Feb. 1967 45 p refs Transl. into ENGLISH from Office Natl. d'Etudes et de Rech. Aerospatiales Report TN-95, 1966
(NASA-TT-F-10729; TN-95) CFSTI: HC $3.00/MF $0.65 CSCL 01A

Studies on a wing with aileron are reported; three types of instability are shown to exist. These occur when: (a) the shock wave is ahead of the hinge; (b) the shock wave is on the aileron; (c) the shock wave is attached to the aileron trailing edge. These three types are encountered in different Mach number ranges. The effects of Reynolds number and aspect ratio are studied for each type. The work has not been extended to thick wings or to high-frequency parameters. Author

N67-25031*# International Information, Inc., Philadelphia, Pa.
ON A FAMILY OF MINIMUM-DRAG BODIES [O SISTEME TEL S MINIMAL'NYM VOLNOVYM SOPROTIVLENIYE]
V. M. Borisov Washington, NASA, Feb. 1967 10 p refs Transl. into ENGLISH from Inzh. Zh. (Moscow), v. 5, no. 6, 1965 p 1028–1034
(Contract NASw-1499)
(NASA-TT-F-10640) CFSTI: HC $3.00/MF $0.65 CSCL 01A

The author investigates two variational problems of supersonic gas dynamics on the determination of the shape of minimum-drag axisymmetric bodies. In the first problem, such a configuration consists of a generatrix passing through three fixed points. In the second problem, two generatrices pass through two pairs of fixed points (channel flow). The analysis is founded on the exact gas dynamic equations. The flow equations are viewed as cobonds which account for the introduction of the Lagrangian multipliers. Author

N67-25048*# Astro Research Corp., Santa Barbara, Calif.
THE FLUTTER OF FLEXIBLE, TOWED TENSION SHELLS
Richard H. MacNeal Washington, NASA, May 1967 50 p refs
(Contract NAS1-5605)
(NASA-CR-777) CFSTI: HC $3.00/MF $0.65 CSCL 01A

A method of aeroelastic analysis for axisymmetric membrane shells is developed and is applied to the flutter of a flared tension cone decelerator attached by a cable to a massive forebody. The principal result is that the presence of elastic shear stiffness in the membrane shell is important for the prevention of flutter. The method of analysis includes consideration of differential stiffness due to pre-tension and of elastic stiffness. Static pressure distribution and aerodynamic influence coefficients are computed from Newtonian impact theory. Author

N67-25078*# General Electric Co., Cincinnati, Ohio. Advanced Technology and Demonstrator Programs Dept.
SINGLE STAGE EXPERIMENTAL EVALUATION OF HIGH MACH NUMBER COMPRESSOR ROTOR BLADING. PART I: DESIGN OF ROTOR BLADING
D. R. Seyler and Leroy H. Smith, Jr. 1 Apr. 1967 83 p refs
(Contract NAS3-7617)
(NASA-CR-54581; GE-R66FPD321, Pt. I) CFSTI: HC $3.00/MF $0.65 CSCL 10A

A set of four axial-flow medium-aspect-ratio compressor rotor blade rows was designed to provide a vehicle for experimental evaluation of the use of blade camberline shape to minimize blade element losses in the high-transonic Mach number region. One blade row was designed for a tip diffusion factor of 0.35 with a tip blade element ratio of supersonic to total camber of 0. The other three blade rows were designed for a tip diffusion factor of 0.45 with tip ratios of supersonic to total camber varying from 0 to 0.65, the value required for a double-circular arc blade element. Author

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N67-23534# Royal Aircraft Establishment, Bedford (England).
RESULTS OF FLIGHT TESTS ON A SLENDER WING LOW SPEED RESEARCH AIRCRAFT (H.P. 115)
P. L. Bisgood Paris, AGARD, May 1966 28 p refs Presented at the 28th Meeting of the AGARD Flight Mechanics Panel, 10-11 May 1966
(AGARD-535) CFSTI: HC $3.00/MF $0.65

Flight tests to determine the stability derivatives of a slender-wing low-speed research aircraft are described, together with miscellaneous supporting tests (including moment of inertia measurements). The results obtained are compared, where possible, with wind-tunnel measurements; in general the level of agreement is satisfactory, but some notable discrepancies occur which are discussed further. The more important handling qualities are described and are compared with existing criteria and with a ground-based simulation of the test aircraft. Contrary to expectation, the aircraft's handling qualities have proved remarkably docile and free from serious problems. Author

N67-23812# Federal Aviation Agency, Atlantic City, N. J. National Aviation Facilities Experimental Center.
V/STOL APPROACH SYSTEM STEEP ANGLE FLIGHT TESTS Interim Report
Glen D. Adams Sep. 1966 46 p ref
(FAA-RD-66-68; AD-646236) CFSTI: HC $3.00/MF $0.65

The report describes results obtained during flight tests with an S-61N helicopter on the Vertical/Short Takeoff-Landing (V/STOL) Approach System (VAPS). The system consists of a solid-state microwave localizer and glide slope operating in the 15,000 Mc/s frequency region. All ground equipment is housed within a 5-foot high radome, 4 1/2 feet in diameter. The localizer bearing and the glide slope angle can be readily changed by hand cranks at the ground station. Fifteen hours of flight time were expended on approaches, with glide slope angle ranging from 3 degrees to 60 degrees. The conclusion is reached that the S-61N helicopter approaches at angles greater than 20 degrees

encountered VAPS equipment limitations - deficient guidance signals, and aerodynamic limitations - marginal control, roughness and excessive descent rates. Author (TAB)

N67-23665# British Aircraft Corp., Preston (England).
T.S.R.2—A COMPARISON OF ACTUAL HANDLING QUALITIES WITH ESTIMATES
W. D. Horsfield Paris, AGARD, May 1966 30 p Presented at the 28th Meeting of AGARD Flight Mechanics Panel, Paris, 10–11 May 1966
(AGARD-534) CFSTI: HC$3.00/MF$0.65

Flight test data are presented on the TSR 2, which was designed as a low level strike aircraft with emphasis on a good penetration distance at very low altitude and at high subsonic speed. Problems due to design configuration are identified as the low aspect ratio surfaces and long fuselage which resulted in nonlinear behavior and difficulties in derivative estimation and definition. The closeness of the primary surfaces also caused substantial interference effects and nonlinearities which involved a substantial increase in wind tunnel testing. Simulation tests were also performed to explore the aerodynamic problems. Pilot opinion on the aircraft's handling qualities is compared with simulation experience and prediction based on various criteria. In general, flight opinion was found to be more favorable than expected; this was due in part to differences in derivatives between flight and estimates based on wind tunnel data. M.G.J.

N67-23796*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A SIMULATOR AND FLIGHT STUDY OF YAW COUPLING IN TURNING MANEUVERS OF LARGE TRANSPORT AIRCRAFT
Walter E. McNeill and Robert C. Innis Washington, NASA, May 1967 39 p refs
(NASA-TN-D-3910) CFSTI: HC$3.00/MF$0.65 CSCL 01C

A piloted simulator study was made of the effects of the aerodynamic yaw coupling parameters (with Dutch-roll period and damping as secondary variables) on the lateral directional handling qualities of a supersonic transport configuration at landing approach airspeed. Based on pilot opinions and measured sideslip excursions in sidestep maneuvers, the desirable combinations of the yaw coupling derivatives tend to be more positive than is typical of current aircraft. Results of flight tests in a large variable stability jet transport show trends similar to those of the simulator data. Some areas of minor disagreement between the simulator and flight results were traced to differences in pilot location with respect to the center of gravity and indicated that pilot consciousness of side acceleration forces can be an important factor in the handling qualities of large aircraft. The results of the present simulator study tend to support the use of the frequency ratio as an indicator of desirable yaw coupling behavior. Author

N67-23818*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
COMPARISON OF FLIGHT-MEASURED HELICOPTER ROTOR-BLADE CHORDWISE PRESSURE DISTRIBUTIONS WITH STATIC TWO-DIMENSIONAL AIRFOIL CHARACTERISTICS
James Scheiman and Henry L. Kelley Washington, NASA, May 1967 56 p refs
(NASA-TN-D-3936) CFSTI: HC$3.00/MF$0.65 CSCL 01C

The blade section normal-force coefficients and centers of pressure of a helicopter rotor blade for two extreme flight conditions were compared with measured static two-dimensional airfoil characteristics. The two extreme flight conditions explored in detail were trim, level flights to obtain blade stall and high blade Mach numbers. Other trim-level-flight conditions were also studied. A comparison of flight-measured characteristics and two-dimensional characteristics showed agreement over most of the rotor disk, but significant differences were found in certain regions on the rotor disk. These differences were largely confined to regions of high normal-force coefficients and, to a lesser degree, to regions at the advancing blade tip where Mach number effects were present. Possible causes of the differences are oscillating airfoil characteristics, preceding blade tip vortex effects, spanwise or yawed flow on the blade, and nonuniform velocity gradients ahead of the blade section. Author

N67-23820*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
GROUND EFFECTS ON A FOUR-PROPELLER TILT-WING CONFIGURATION OVER A FIXED AND A MOVING GROUND PLANE
Kenneth W. Goodson Washington, NASA, May 1967 92 p refs
(NASA-TN-D-3938) CFSTI: HC$3.00/MF$0.65 CSCL 01C

A wind tunnel investigation of a four-propeller tilt-wing V/STOL configuration in ground proximity with and without ground-plane boundary layer was conducted. Tests were made at transition speed conditions to determine the effect of ground proximity and the effect of ground-plane boundary layer on the measured aerodynamic results. The investigation showed that considerable reductions in lift and drag coefficients occur for some wing-flap angle combinations when the tilt-wing configuration is moved into ground proximity under near-equilibrium thrust conditions. The adverse effects of the ground on the lift coefficients are intensified under accelerating thrust conditions. Under accelerating conditions, the drag coefficient is also further reduced and this reduction should aid the acceleration. For high lift, high thrust conditions, the presence of a boundary layer on the wind-tunnel ground plane causes a reduction in the lift and drag coefficients in ground effect for the tilt-wing configuration. Effects of ground-plane boundary layer are evident in both the tail-off and tail-on pitching moments. The results show that wind tunnel ground-effect tests of tilt-wing configurations should be made with ground-plane boundary layer removed if ground-effect aerodynamic characteristics are to be simulated, especially for high-lift, high-thrust conditions. Author

N67-23861# Lockheed-California Co., Burbank.
PARAMETRIC ANALYSIS AND PRELIMINARY DESIGN OF A SHAFT-DRIVEN ROTOR SYSTEM FOR A HEAVY-LIFT HELICOPTER Final Report, Jan.–Oct. 1966
Vahe Bilezikjian, James M. Brye, Harry M. Childers, William J. Conway, Harry D. Goldstein et al Aug. 1966 328 p refs
(Contract DA-44-177-AMC-276(T))
(LR-19143; USAAVLABS-TR-66-48; AD-640946) CFSTI: HC $3.00/MF$0.65

A parametric analysis and a preliminary design study were conducted to determine the optimum characteristics of a shaft-driven rotor which would result in the lightest gross weight helicopter capable of lifting military loads in the 12- to 20-ton range. The study considered single- and tandem-rotor helicopters with internal cargo and cargo pod. Types of rotors analyzed were articulated, teetered, rigid, and matched-stiffness. Existing turbine engines or growth versions thereof were considered. Component weight equations were developed and a computer program was utilized to determine the rotor characteristics for each helicopter configuration. For a given set of rotor parameters, the program computed the power plant rating, fuel required, and the empty weight corresponding to the helicopter which would satisfy the most critical mission requirements with the minimum gross weight. The performance of the resulting configuration was determined. Design studies of the rotor system, rotor controls, rotor/propulsion arrangement, and the general arrangement were made. Rotor loads were developed and a structural design analysis of the rotor system, including fatigue and weight analyses, was prepared. A dynamic and aeroelastic investigation of the rotor system and a stability and control study of the helicopter were conducted. The study indicates that the single-rotor helicopter incorporating a matched-stiffness rotor system

would have a gross weight of 62,500 pounds for 12-ton payload range and 74,727 pounds for the 20-ton payload range. These gross weights are 4- to 6-percent less than the other configurations studied. Author (TAB)

N67-23866# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONTROL OF SUPERSONIC AIRCRAFT
F. I. Sklyanskiy 31 May 1966 385 p refs Transl. into ENGLISH of the book "Upravlenige Sverkhzvukovoga Samoleta" Moscow, Mashgiz., 1964 p 1–388
(FTD-MT-65-89; TT-67-60323; AD-644145) CFSTI: HC $3.00/MF $0.65

Contents: General information, equations of motion, definitions; Stability and controllability characteristics of aircraft, formation of forces on control levers of aircraft with non-power-assisted (boosterless) control systems; Change of characteristics of stability and controllability of aircraft at transonic and supersonic speeds of flight; Improvement of stability and controllability characteristics by methods of aerodynamic design and selection of shapes of supersonic aircraft; Power control formation of forces on aircraft control levers with power control; Application of automatic devices for improvement of characteristics of dynamic stability and controllability of present-day aircraft; Certain questions of the further development of control systems; The influence of deformation of the aircraft structure on its stability and controllability; Increase of safety of flight and emergency control. TAB

N67-23921# Beech Aircraft Corp., Wichita, Kans.
TURBINE-DRIVEN NU-8F LIAISON TEST BED Final Report
Apr. 1966 126 p refs
(Contract DA-44-177-AMC-27(T))
(Rept.-20009; USAAVLABS-TR-66-22; AD-645216) CFSTI: HC $3.00/MF $0.65

The development and flight test program of the NU-8F was conducted. A Beech Model U-8F was modified by the installation of two UACL PT6A-6 turbine engines in place of the reciprocating engines, and by replacing the stabilizer and rudder with a Beech Model A80 stabilizer and rudder. Ground and flight tests were conducted using FAA regulations as the standard of acceptability. The report contains a comparison of performance characteristics of the NU-8F and the U-8F. A discussion of each phase of the performance tests along with tables and graphs of the flight test data is presented in some detail. The NU-8F has more useful load, increased speed, and a more simple fuel system than the U-8F. It is suitable for use as a turbine-powered trainer or as a liaison and transportation aircraft. Author (TAB)

N67-23981 France. Direction de la Meteorologie Nationale, Paris.
REPORTS PRESENTED TO THE SUBCOMMITTEE ON METEOROLOGY OF THE PERMANENT COMMITTEE ON THE SUPERSONIC TRANSPORT [RAPPORTS PRESENTES A LA SOUS-COMMISSION DE METEOROLOGIE DE LA COMMISSION PERMANENTE DU TRANSPORT SUPERSONIQUE]
R. Garnier, L. Thibord, and P. Duverge Sep. 1965 307 p refs In FRENCH
CFSTI: $3.00

CONTENTS:

1. TEMPERATURE LEVELS OF FLYING SUPERSONIC TRANSPORT PLANES R. Garnier 103 p refs (See N67-23982 12-02)

2. THE SUPERSONIC BOOM L. Thibord 71 p refs (See N67-23983 12-02)

3. CLOUDS, PRECIPITATION, ICING, STORMS, TURBULENCE AND THEIR CONSEQUENCES ON THE SUPERSONIC FLIGHTS P. Duverge 122 p refs (See N67-23984 12-02)

N67-23982 France. Direction de la Meteorologie Nationale, Paris.
TEMPERATURE LEVELS OF FLYING SUPERSONIC TRANSPORT PLANES [TEMPERATURES AUX NIVEAUX DE VOL DES AVIONS DE TRANSPORT SUPERSONIQUES]
R. Garnier *In its* Rept. Presented to the Subcomm. on Meteorol. of the Perm. Comm. on the Supersonic Transport Sep. 1965 103 p refs In FRENCH (See N67-23981 12-02)

Air temperature influencing thermodynamic movements are investigated in a study of supersonic transport flights. Consideration is given to the the masses of hot air affecting supersonic aircraft performance, particularly in regard to propulsion and ambient air temperature. Technical data are presented on annual and daily variations of stratospheric temperature, as well as sudden abrupt temperature changes. Extensive graphics accompany these data. Transl. by R.Ll.

N67-23983 France. Direction de la Meteorologie Nationale, Paris.
THE SUPERSONIC BOOM [LE BANG SUPERSONIQUE]
L. Thibord *In its* Rept. Presented to the Subcomm. on Meteorol. of the Perm. Comm. on the Supersonic Transport Sep. 1965 71 p refs In FRENCH (See N67-23981 12-02)

Sonic boom effects are reviewed in relation to supersonic transport flights. Stress is placed on the noise level tolerance of human populations. In this case, the decibel is not considered ideal to measure the tolerance level since the effects of surprise of the bang-detonation must be taken into consideration for individual cases. Meteorological methods of measuring shock waves are also discussed. Transl. by R.Ll.

N67-23984 France. Direction de la Meteorologie Nationale, Paris.
CLOUDS, PRECIPITATION, ICING, STORMS, TURBULENCE AND THEIR CONSEQUENCES ON THE SUPERSONIC FLIGHTS [NUAGES, PRECIPITATIONS, GIVRAGE, ORAGES, TURBULENCE ET LEURS CONSEQUENCES POUR LES VOLS SUPERSONIQUES]
P. Duverge *In its* Rept. Presented to the Subcomm. on Meteorol. of the Perm. Comm. on the Supersonic Transport Sep. 1965 122 p refs In FRENCH (See N67-23981 12-02)

Cloud formation and ancillary phenomena, such as precipitation and icing, are considered for aerial navigation applications. Meteorological and climatological problems, particularly the presence of water vapor, are becoming of increasing importance for supersonic transport flights. The following concepts are also considered: mixing, high altitude humidity, mechanism of condensation, freezing of water droplets, cloud classification, hailstones, and aerodynamic turbulence. Pertinent weather maps and an extensive bibliography are also presented. Transl. by R.Ll.

N67-24022 Brussels Univ. (Belgium). Inst. of Applied Mechanics.
DESCRIPTION OF THE EXPERIMENTAL AIR CUSHION VEHICLE PV-1 OF THE UNIVERSITY OF BRUSSELS [DESCRIPTION DU VEHICULE EXPERIMENTAL A COUSSIN D'AIR PV-1 DE L'UNIVERSITE DE BRUXELLES]
A. Jaumotte, A. Kiedrzynski, and J. Servais 1966 43 p In FRENCH
(Contract DRME-79/65)
(NT-7; Rept.-2, Pt. 1)

The experimental vehicle of the PV-1 air cushion vehicle is briefly analyzed for its aerodynamic characteristics. The flying platform design, using the principle of a peripheral jet, is discussed in terms of stability, propulsion system, free flight, guidance, and navigation. The 15 kW motor functions in combination with horizontal axes parallel to the motor axis. Transl. by R.Ll.

N67-24038 Aeronautical Research Council (Gt. Brit.)
A PRELIMINARY FLIGHT SIMULATION STUDY OF JET-BORNE V.T.O.L. AIRCRAFT HANDLING QUALITIES
D. H. Perry and H. W. Chinn London, HMSO, 1967 73 p refs Supersedes RAE-TR-65128; ARC-27367
(ARC-CP-902; RAE-TR-65128; ARC-27367) HMSO: 14s

A piloted flight simulator, having cockpit motion in pitch and roll, together with a simplified visual representation of the outside world, has been used to study attitude control requirements for jet-borne VTOL aircraft in hovering flight and low speed maneuvering. Values of control effectiveness and aircraft rate damping which were found to give satisfactory control characteristics in roll and pitch are presented and compared with the results of previous studies and with VTOL control criteria. Brief studies of some nonlinear control gearings, and tests of pilots' control following autostabilizer failure, are also reported. Author

N67-24039 Aeronautical Research Council (Gt. Brit.)
MEASUREMENT OF THE MOMENTS OF INERTIA OF THE HANDLEY PAGE HP115 AIRCRAFT
L. J. Fennell London, HMSO, 1967 49 p refs Supersedes RAE-TR-65203; ARC-27778
(ARC-CP-907; RAE-TR-65203; ARC-27778) HMSO: 9s 6d

Measurement of the moments of inertia in pitch, roll, and yaw, and of the inclination of the principal inertia axis have been made on the HP115 slender wing research aircraft. In pitch and roll a spring constrained oscillatory technique was used, while in yaw the aircraft was suspended as a torsional pendulum. The inclination of the principal inertia axis was found by varying the attitude of the aircraft on the rolling and yawing rigs. Measurements were made with fuel tanks full and empty. An estimate of the accuracies of the techniques used showed that the inertias could be measured to within ±2%, ±5%, and ±1% for the pitch, roll, and yaw axes respectively. The inclination of the principal axes could be determined to within ±0.1°. After allowing for the virtual inertia of the surrounding air mass, the experimental values were less than the manufacturers estimates in pitch and roll but greater in yaw. The largest discrepancy was approximately 5%. The measured inclination of the principal axis was considerably less than the estimate—3.95° instead of 5.1°. Author

N67-24044# Federal Aviation Agency, Oklahoma City, Okla.
RECOMMENDATIONS FOR SHOULDER RESTRAINT INSTALLATION IN GENERAL AVIATION AIRCRAFT
Joseph W. Young Sep. 1966 23 p
(AM-66-33; AD-646054) CFSTI: HC $3.00/MF $0.65

The use of inadequate or incomplete body restraint systems is a major factor in the current trend of increasing serious and fatal type injuries reported from general aviation accidents. An analysis of these accident injuries and conditions clearly indicates that the use of a seat belt without additional upper body restraint cannot provide adequate protection. This project was initiated to study the feasibility of upper body restraint installation in general aviation aircraft. The primary concern of this study is to select specific locations on internal structures that can be recommended as points of upper restraint attachment without major structural modification. A series of five basic makes, models, and types of general aviation aircraft were dynamically tested on an acceleration track to evaluate the structural integrity of each area selected for restraint attachment. Structure deceleration peaks in excess of 20gs occurred from onset rates of 47-49 ft./sec. and event durations of .33 sec. All recommended areas for restraint attachment were found reliable for minimum dynamic loads of 500 pounds. Author (TAB)

N67-24318* Scientific Translation Service, La Canada, Calif.
STUDY OF DYNAMIC LONGITUDINAL STABILITY OF AIRCRAFT IN CONSTANT GLIDE PATH ANGLE [STUDIE MET BETREKKING TOT DE DYNAMISCHE LANGSSTABILITEIT VAN VLIEGTUIGEN BIJ CONSTANTE BAANHOEK]
H. Ramakers Washington, NASA Mar. 1967 45 p refs Transl. into ENGLISH from Dutch
(Contract NASw-1496)
(NASA-TT-F-10792) CSCL 01D

A theoretical investigation is made of a special form of constrained stability, so-called speed stability. In particular different forms of controlling the glide path of the aircraft, ranging from exactly constant glide path to the stick fixed case are discussed. In all cases use is made of the root locus method, which shows the variation of the roots of the characteristic equation with the gain of the autopilot providing the control. Numerical results are given for the example of a medium size jet aircraft. Author

N67-24586 Royal Aircraft Establishment, Farnborough (England).
PROBLEMS OF THE DYNAMICS AND CONTROL OF VTOL AIRCRAFT: OPTIMUM GUIDANCE AND STABILITY [PROBLEMES DE DYNAMIQUE ET DE COMMANDE DES AVIONS VTOL GUIDAGE OPTIMAL ET STABILITE]
T. Hacker Oct. 1966 28 p refs Presented at the 4th Congr. of the Inter. Council of the Aeronautical Sci., Paris, 24–28 Aug. 1964
(RAE-LIB-TRANS-1186; ICAS-64-566) CFSTI: $3.00

Consideration is given to the theory of optimum guidance of VTOL aircraft during the climb in order to ensure minimum fuel consumption and minimum time to achieve a given height. Pontryagin's maximum principle is used as the basis for the work and aircraft with either fixed or movable thrust axes are considered. The theory of stability of VTOL aircraft is also discussed. Expressions are given for the characteristics of the disturbed motion in the hover taking into account delay in the servo systems. A method of approach is suggested for the problem of controlled transitional flight for the case of an autopilot with a delay. Author

N67-24619*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A FLIGHT AND SIMULATOR STUDY OF DIRECTIONAL AUGMENTATION CRITERIA FOR A FOUR-PROPELLERED STOL AIRPLANE
Hervey C. Quigley, Robert C. Innis, Richard F. Vomaske, and Jack W. Ratcliff Washington, NASA, May 1967 41 p refs
(NASA-TN-D-390-9) CFSTI: HC $3.00/MF $0.65 CSCL 01C

A flight and simulator investigation has been conducted to determine the directional augmentation required for satisfactory lateral-directional handling quantities at low approach speeds for a large STOL airplane. The results showed that augmentation was required to reduce sideslip excursion during lateral maneuvering and to increase the directional damping. Satisfactory directional characteristics were achieved with an augmentation system that drove the rudder in proportion to roll rate and aileron deflection to improve turn coordination and in proportion to rate change of sideslip to increase directional damping. This augmentation enabled the evaluating pilots to make acceptable hooded instrument landing approaches. The unsatisfactory lateral characteristics of the airplane prevented complete evaluation of the airplane in STOL operation. Author

N67-24844# Naval Ordnance Test Station, China Lake, Calif.
A METHOD FOR PREDICTING PERFORMANCE OF OPEN SEAT EGRESS SYSTEMS
W. J. Stone and W. B Stelwagon Nov. 1966 68 p
(NOTS-TP-3551; NAVWEPS-8542; AD-646650) CFSTI: HC $3.00/MF $0.65

Description and principles of operation of a computer program called EMEREG are discussed. Samples of program output are included and compared to data from actual tests. Instructions for using the program are included. Author (TAB)

N67-24850# California Univ., Berkeley. Inst. of Transportation and Traffic Engineering.
EFFECT OF LANDING-LIGHT BACKSCATTER ON TARGET VISIBILITY IN FOG Final Report
D. M. Finch, E. C. Curwen, and L. King Sep. 1966 36 p refs
(Contract FAA-ARDS-436)
(FAA-RD-66-60; AD-646843) CFSTI: HC $3.00/MF $0.65

Tests were conducted in the FAA Fog Chamber to determine if backscatter from aircraft landing lights in visual ranges of 3 mi, 2600 ft, and 1200 ft would interfere with an observers ability to see a set of amber target lights at the runway threshold. Results from a total of 518 test observations, made by 14 observers, indicate substantially no reduction in target-light visibility in visual ranges of 3 mi and 2600 ft. In the 1200-ft visual range, the visibility of the target lights was reduced by an appreciable amount. TAB

N67-24883# Army Aviation Materiel Labs., Fort Eustis, Va.
CARGO COMPARTMENT OPTIMIZATION STUDY, ARMY TRANSPORT AIRCRAFT Final Report
J. A. Vichness and J. A. Deacon Sep. 1966 69 p refs
(USAAVLABS-TR-66-79; AD-645873) CFSTI: HC $3.00/MF $0.65

The purposes of this task were to formulate an appropriate study framework for investigating the effects of cargo-compartment size on the utility of Army transport aircraft and to collect the necessary basic data to support such a study. The ultimate objective was the development of a methodology that would enable the judicious design selection of optimal compartment dimensions. A workable methodology was derived following a thorough review of previous cargo-compartment sizing analyses for transport aircraft. This parametric-type analysis includes a fit-compatibility phase for deriving a set of minimum desirable compartment dimensions, a transport-efficiency phase for modifying these minimum dimensions if warranted from efficiency considerations, and a historical-comparison phase for comparing the design dimensions with those of previously built aircraft. Since an efficient compatibility between the aircraft and the transportable cargo is necessary to realize proper utilization of the aircraft capabilities, it is essential to conduct a thorough, detailed selection of the cargo-compartment dimensions early in the design phases for future Army transport aircraft. Author (TAB)

N67-25003*# National Aeronautics and Space Administration, Washington, D. C.
SPIN TESTS: METHOD OF DATA PRESENTATION
J. Gobeltz Mar. 1967 6 p Transl. into ENGLISH of the book "Methode de Presentation des Resultats" Lille
(NASA-TT-F-10812) CFSTI: HC $3.00/MF $0.65 CSCL 01B

The method of data presentation for wind tunnel spin tests, used by the Lille Institute of Fluid Dynamics, is described with classification of spin types and spin recovery, influence of control surface setting on spin recovery, nomenclature and symbols used, and application of wind tunnel data to full-scale aircraft. Author

N67-25004*# National Aeronautics and Space Administration, Washington, D. C.
DEVELOPMENT OF SPIN TESTING TECHNIQUE AS A FUNCTION OF SPIN OF MODERN AIRCRAFT
J. Gobeltz Mar. 1967 10 p Transl. into ENGLISH of the book "Evolution de la Technique des Essais de Vrille en Fonction des Vrilles des Avions Recents" Lille, 1959
(NASA-TT-F-10811) CFSTI: HC $3.00/MF $0.65 CSCL 01B

Recent improvements in the testing technique at the vertical wind tunnel of the Lille Institute for Fluid Dynamics are discussed, followed by a review of spin classification and spin recovery. Test data of spin models, are extrapolated to full-scale aircraft with guidelines for setting of the control surfaces. Addition of auxiliary surfaces, such as keelsons and fairings, is evaluated in relation to more rapid recovery from spin. Author

N67-25037*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
EVALUATION OF A VERTICAL-SCALE, FIXED-INDEX INSTRUMENT DISPLAY PANEL FOR THE X-15 AIRPLANE
Lee E. Lytton Washington, NASA, May 1967 28 p refs
(NASA-TN-D-3967) CFSTI: HC $3.00/MF $0.65 CSCL 01D

A comparative evaluation was performed on an analog simulator to compare pilot performance when using the operational X-15 instrument panel and a panel incorporating vertical-scale, fixed-index flight instruments. The purpose was to provide experimental evidence to complement pilot opinion concerning the acceptability of the vertical-scale panel for use in the X-15 airplane. This evidence was obtained in the form of a wide variety of performance measures for 16 subjects, for two different representative mission profiles, and over three trials or runs for each profile. The data were subjected to both parametric and nonparametric statistical analysis. Performance differences between panels were largely either insignificant or were masked by variability within subjects. Pilot opinion, as expressed in questionnaires, generally supported this result, in that performance levels for the two panels were judged to be equivalent. Pilot reports, after five X-15 flights, indicate increasing acceptance of the vertical-scale panel as well as operational substantiation of the results of the simulator evaluation. Author

N67-25046*# General Electric Co., Cincinnati, Ohio.
LIFT FAN TECHNOLOGY STUDIES
Zygmunt J. Przedpelski Washington, NASA, Apr. 1967 315 p refs
(Contract NAS2-3077)
(NASA-CR-761) CFSTI: HC $3.00/MF $0.65 CSCL 21E

Extensive thermodynamic, aerodynamic, mechanical, and systems studies defined the interrelationships among the various engine and fan design parameters. With this knowledge, an optimum fan design can be identified for any given requirement. Fan installation thickness reduction was stressed throughout; new mechanical and aerodynamic designs were evolved to satisfy the requirements of supersonic fan-in-wing installations. Five lift fans of 1.18 to 1.28 pressure ratio were preliminarily designed based on the results of this study and the extensive lift fan design experience. Three of these fans (13,650 pounds lift each) were designed for minimum thickness, compatible with a supersonic fan-in-wing fighter aircraft installation. The other two fans (26,000 pounds lift each) were designed for a V/STOL transport, with primary emphasis on low weight. Lift to weight ratios of over 20 to 1 were achieved with four of the five designs. Data are provided for scaling each fan, plus-or-minus 30 percent of its nominal lift. Author

N67-25055*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
WIND-TUNNEL TESTS OF A SERIES OF PARACHUTES DESIGNED FOR CONTROLLABLE GLIDING FLIGHT
James A. Weiberg and Kenneth W. Mort Washington, NASA, May 1967 40 p refs
(NASA-TN-D-3960) CFSTI: HC $3.00/MF $0.65 CSCL 01C

It was found that the glide capability of parachutes was affected by the canopy configuration. The maximum lift–drag ratio achieved was approximately 2.1 and was attained by two parachutes—a rectangular canopy, and a 3-lobe canopy. This performance was generally obtained with some loss in stability, particularly at low lift–drag ratios corresponding to nearly vertical descent. Limited results of an investigation of two reefed configurations are also presented. Author

N67-25058*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FLIGHT INVESTIGATION OF V/STOL HEIGHT-CONTROL REQUIREMENTS FOR HOVERING AND LOW-SPEED FLIGHT UNDER VISUAL CONDITIONS

James R. Kelly, John F. Garren, Jr., and Perry L. Deal Washington, NASA, May 1967 22 p refs
(NASA-TN-D-3977) CFSTI: HC $3.00/MF $0.65 CSCL 01C

Tests included both precision and maneuvering tasks, under visual conditions, and were conducted with a variable-stability helicopter. Variations were made in maximum thrust–weight ratio, normal-velocity damping, sensitivity of the height control lever, and time delays in the thrust response. The results indicated that the task involving acceleration from hover, and the subsequent climbout, imposed a more stringent requirement on thrust–weight ratio than deceleration at the bottom of the approach, which is generally assumed to be the most critical task of all. For normal operations as reflected by the primary evaluation task, the minimum satisfactory level of thrust–weight ratio was 1.09 providing other parameters were within a range which permitted a climb capability of at least 600 feet per minute (3 meters per second). Considering the approach tasks alone, thrust–weight ratios as low as 1.03 were satisfactory if the normal-velocity damping level was equal to or greater than −0.25 1/second. Author

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N67-23646*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACECRAFT POWER
In its Supporting Res. and Advanced Develop. 28 Feb. 1967 p 62–69 refs (See N67-23641 12-11)

Rollup solar array, thermoelectric failure mode testing, a sterilizable battery, and variations of surface potential during the oxidation of silver electrodes at constant current are discussed in relation to spacecraft power. Deployable beams are used for the solar array, and the deployment concept requires a capacitor-induction electric motor geared to the 12-in-D wrap drum by a magnesium ring gear. Impact and sublimation testing are reported for thermoelectric design concepts, and eight fully-integrated thermoelectric couple testers were subjected to a wide variety of environmental conditions. Separator development for sterilizer batteries is described, as are the electrochemical, cell case, and cell fabrication and test tasks for these batteries. Results are given for the investigation of the reaction geometry at electrode surfaces. M.W.R.

N67-23647*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACECRAFT CONTROL
G. E. Fleischer *In its* Supporting Res. and Advanced Develop. 28 Feb. 1967 p 70–107 refs (See N67-23641 12-11)

Spacecraft antenna pointing, sterilization of the capsule control system, and a propulsive lander control system are among the research projects dealing with spacecraft control. A digital simulation language, developed by IBM as a "share" program, is described that permits the integration of ordinary differential equations with extremely simplified programming. Solution of linear multipoint boundary value problems, least squares fit to data, and a program description are included. Other investigations deal with millipound attitude control actuator development, strapdown electrically suspended gyro data reduction computer programs, and an optical sensor concept for guidance and control of a soft landing spacecraft. M.W.R.

N67-23648*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
GUIDANCE AND CONTROL RESEARCH
In its Supporting Res. and Advanced Develop. 28 Feb. 1967 p 108–120 refs (See N67-23641 12-11)

Cesium vapor heat conduction in thermionic energy converters, space charge distribution in a neutral plasma, and titanium oxide thin films are discussed. An empirical equation for determining interelectrode spacing in converters yields results comparable to those obtained by differential expansion calculations. The experimental method is particularly useful when calculation methods fail because of fabrication errors. The theory of variable mobilities and its application are discussed in relation to a neutral plasma, and it is concluded that the current conduction in a cesium plasma, such as exists in thermionic converters, can be described more accurately if electron-ion collisions are considered. M.W.R.

N67-23732# Mechanical Technology, Inc., Latham, N. Y.
EXPERIMENTAL TEST AND EVALUATION OF A GAS-BEARING CYCLE TURBOCOMPRESSOR Progress Report, 20 Jun.–1 Sep. 1966
J. S. Meacher 15 Dec. 1966 262 p
(Contract AT(30-1)-3237)
(NYO-3237-7) CFSTI: HC $3.00/MF $0.65

Feasibility of, and problem areas associated with, the application of gas-lubricated bearings to closed-system gas-turbine machinery are discussed. A Brayton cycle gas generator (turbocompressor) utilizing self-acting gas bearings was designed, built, and is being tested. Self-sustained closed-loop operation of the turbocompressor, using its own cycle gas as the bearing lubricant, was achieved. The turbocompressor has been successfully operated, with nitrogen at 1300°F (design point) and 1400°F (design maximum) turbine inlet temperature and at a speed of 24,000 rpm. The turbocompressor has also been operated under "no-load" and "load" conditions in argon at turbine inlet temperatures up to 1355°F. Tests were made to determine the dynamic response of the turbocompressor-loop system to transients in loop pressure level, compressor bleed flow, and throttle valve setting. Plots of response data are presented for these transient tests and for heater power and compressor inlet temperature transient tests. A number of steady-state test points were taken with the turbocompressor operating at 30 psia compressor inlet pressure (the design value is 15 psia). Additional turbocompressor performance test data were secured using argon for the loop working fluid and bearing lubricant gas. The maximum average turbine inlet temperature during these argon runs was 1355°F. A new hydrostatic-hydrodynamic thrust bearing has been designed, fabricated, and installed on the turbocompressor. NSA

N67-23872# Naval Research Lab., Washington, D. C.
HIGH RATE BATTERIES
C. M. Shepherd and H. C. Langelan 30 Sep. 1966 22 p refs
(NRL-6448; AD-645942) CFSTI: HC $3.00/MF $0.65

The capacity and efficiency of a battery increase rapidly as the porosity of the active materials in the plates is increased. At porosities of 85 to 90 percent, ampere-hour efficiencies of more than 50 percent were obtained in discharge times of as little as one minute over a range of temperatures extending down as low as -60C. Metal plates of controlled porosities and high surface areas were produced by the electrolytic reduction of metal compounds subjected to controlled physical pressure during electrolysis. Anodic active materials were prepared in an analogous manner. The active materials thus prepared and tested included zinc, cadmium, lead, Ag_2O and AgO, all of which provided highly successful electrode materials. The results of tests on these materials indicate that the technique can be applied to many more active materials, thus pointing the way to the production of a wide range of extremely high-rate, low-temperature batteries. TAB

N67-23970*# National Aeronautics and Space Administration Goddard Space Flight Center, Greenbelt, Md.
A LOW NOISE SWITCHING CONVERTER-REGULATOR FOR MAIN POWER CONTROL IN A SPACE POWER SYSTEM
Thomas A. La Vigna Nov. 1966 42 p refs
(NASA-TM-X-55758; X-716-66-554) CFSTI: HC $3.00/MF $0.65 CSCL 10B

A variable ratio dc transformer regulator used in a voltage boost configuration to process the main vehicle power from a solar array battery power system in the Radio Astronomy Explorer (RAE) spacecraft, is described. The selection of the design approach for the switching regulator is presented, together with an analysis of its operation and definition of its characteristics, functional performance, and test results. The regulator transforms a variable voltage input to a constant average voltage by constant-frequency pulse width modulation. Two major advantages are high efficiency and essentially constant thermal dissipation over a wide range of input power. The boost configuration employs a power transformer and transistor switches to handle only boost power. This method significantly reduces the RF interference generated in switching as compared to other series-switching regulation techniques, for voltage set-up, or step-down. Circuit elements, the mode of regulation, and packaging arrangement were all developed to minimize RF interference with the least sacrifice of performance. Author

N67-24367# Teledyne, Inc., Gardena, Calif. Inet Power Div.
POWER SYSTEM SYNTHESIZER Final Report, 22 Dec. 1964–1 Dec. 1966
Harry W. Middlecoff Port Hueneme, Calif., Naval Civil Eng. Lab., Jan. 1967 24 p
(Contract NBy-62159)
(F-15568; CR-67.021; AD-647743) CFSTI: HC $3.00/MF $0.65

The power synthesizer is capable of simulating power line faults and includes the means of generating, programming and recording a family of output voltage, frequency and other transient power conditions. The transient output from the power system synthesizer can be applied to critical electronic equipment. Author (TAB)

N67-24405# Rocketdyne, Canoga Park, Calif. Small Engine Div.
INVESTIGATION OF A MOVING BELT RADIATOR Quarterly Progress Report, 1 Nov. 1966–31 Jan. 1967
Feb. 1967 35 p refs
(Contract AF 33(615)-2813)
(R-6289-7; AD-647824) CFSTI: HC $3.00/MF $0.65

Study was continued on a research program of the moving belt radiator, a novel concept for the rejection of waste heat in space. The dynamic model was used to continue belt shape studies. Pressure transducers were placed in the dynamic model drum and used to measure belt pressures during the checkout tests of the pressure transducer system. Author (TAB)

N67-24435# Kiel Univ. (West Germany). Labor fuer Bio.-Med. Elektronik.
METHODS OF THE TRANSMISSION OF BIOLOGICAL DATA UNDER SPACE FLIGHT REQUIREMENTS [METHODEN DER BIOLOGISCHEN DATENUEBERTRAGUNG UNTER RAUMFAHRTBEDINGUNGEN]
P. Osypka *In* Arbeitsgruppe Biophys. Raumforsch. Extraterrest. Biophys. and Biol. [1966] p 79–83 (See N67-24424 12-11)

This survey covers newly developed measuring and transmission systems of interest for biological data observation during space flight. Energy sources for scientific onboard instrumentation include batteries, fuel cells, and chemical reactors for short duration flights; solar-thermionic systems and combined solar cells with nickel-cadmium batteries are applicable for flights of several weeks; and radioactive power sources are useful in long duration space missions. A pulse code modulation system is most advantageous for data signal transmission from the spaceship to ground station and storage and for clinical supervision of the astronauts. Transl. by G.G.

N67-24485# Marine Engineering Lab., Annapolis, Md.
EFFECTS OF PH ON THE ELECTROSORPTION OF OXYGEN ON FUEL CELL ELECTRODES
D. E. Icenhower, H. B. Urbach, and J. H. Harrison Jan. 1967 36 p refs
(MEL-406/66; AD-647691) CFSTI: HC $3.00/MF $0.65

A new potential-step method was used to determine oxygen coverage on platinum, gold, and rhodium. The procedure was based, in part, on the use of a novel electronic coulometer. Experimental evaluation of the coverage and its theoretical interpretation were obtained by the use of the potential-step method in conjunction with the potential-sweep method. The pH was found to have profound effects upon the oxygen coverage. In general, increasing pH increases the degree of coverage by oxygen-containing species. This effect may be correlated with the amphoteric properties of bulk metals wherein it is observed that pH influences the formation of hydroxide species and finally the reaction of the hydroxide species to form oxides. The hydroxide species appears to represent an intermediate in the formation of the oxide. The oxygen coverage on platinum is a linear function of potential above 0.8 volt. Author (TAB)

N67-24495# Battelle Memorial Inst., Columbus, Ohio. Columbus Labs.
BONDING EVALUATION STUDY OF HPD THERMOELECTRIC PROGRAM OPTIMUM-LENGTH INVESTIGATION Technical Report, 30 Jun.–30 Nov. 1966
P. E. Eggers, J. J. Mueller, G. Kramer, and T. S. Shilliday 15 Dec. 1966 48 p refs
(Contract DA-44-009-AMC-1824(X))
(AD-647812) CFSTI: HC $3.00/MF $0.65

The report deals with a bonding evaluation study connected with a program to determine the optimum length of the thermoelectric arms in a thermoelectric power generator in order to achieve the maximum power density. The study consisted of a review of the literature to survey the state of the art in bonding PbTe-type thermoelectric generator materials to metallic conductors and of related experimental work. The available literature was insufficient as a basis for selecting the best bonding techniques for PbTe and related materials. Four bonding methods were considered in the experimental program. Mean values of contact resistivity were found to be relatively low for all types except pressure contacts. All except the powder-interlocking bonds were undesirably subject to fracture. Mean contact resistivities observed in this type of bond to p-type PbSnTe were approximately 4, 9, and 18 microhm-sq cm at 80 F, 500 F, and 900 F, respectively. For n-type PbTe, corresponding mean contact resistivities were 6, 18, and 48 microhm-sq cm. Author (TAB)

N67-24617*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HIGH-VOLTAGE CHARACTERISTICS OF A LARGE-GAP COAXIAL-CYLINDER ELECTRODE
Kenneth F. Koral Washington, NASA, May 1967 24 p refs
(NASA-TN-D-3949) CFSTI: HC $3.00/MF $0.65 CSCL 10B

Measurements of prebreakdown currents, conditioning rates, and ultimate voltage capability were made for a 30-centimeter gap, concentric cylinder configuration in a continuously pumped vacuum environment. Both micropulsing and continuous currents flowed across the vacuum gaps at voltages above a threshold value. A linear dependence of threshold voltage on the total charge that had traversed the gap was found for a certain range of conditions. The ultimate vacuum gap voltage with a positive inner cylinder was 395 kilovolts at 10^{-7} torr and greater than 600 kilovolts at an optimum background gas pressure (approximately

2×10^{-4} torr). Tests showed that a 44-centimeter-long polycarbonate insulator with negative junction shielding operated well at voltages up to 600 kilovolts. Experimental results did not correlate well with either the field emission or the particle exchange theory of prebreakdown conduction. Author

N67-24620*# National Aeronautics and Space Administration. Lewis Research Center, Ohio.

EXPERIMENTAL STUDY OF DYNAMICS OF MERCURY-VAPOR CONDENSING

Roland C. Fisher Washington, NASA, May 1967 37 p refs
(NASA-TM-X-1373) CFSTI: HC$3.00/MF$0.65 CSCL 10B

The dynamic characteristics of a single-tube mercury vapor condenser cooled by gas in crossflow configuration were determined by cycling of the inlet-vapor-flow rate to the condenser. The interface location was allowed to vary freely in response to changes in condensing pressure. Simultaneous responses of condenser-inlet pressure and liquid–vapor interface position to an approximately sinusodial variation in vapor flow rate about a given quiescent level were obtained. The response range investigated was primarily between 0.01 and 1 cycle per second. The responses are presented in the form of Bode plots. The condenser was observed to have two distinct regions of operation identifiable by a high or a low sensitivity of inlet pressure to interface position. In the low-sensitivity region, the frequency response data of condenser pressure to vapor-flow rate indicate an approximate lag-lead-lag characteristic. In the high-sensitivity region, the frequency response data indicate an approximate lead-lag-lag characteristic. The response of interface position to vapor flow rate is presented for the region of low sensitivity of inlet pressure to interface position and also for the transition region. An approximate overdamped second-order response was obtained. The effect of increasing the liquid-pressure drop was moved to lower frequencies of the interface response. Author

N67-24704# Colorado Univ., Boulder. Dept. of Electrical Engineering.

NON-LINEAR ANALYSIS OF HETEROPOLAR ELECTROMECHANICAL ENERGY CONVERTERS. PART II: ANALYSIS OF LARGE TURBO-GENERATORS Final Report

Edward A. Erdelyi Aug. 1966 56 p refs
(Contract Nonr-1147(14))
(AD-646371) CFSTI: HC$3.00/MF$0.65

The analysis presented in this paper using a composite system of coordinates, separation of stator and rotor coordinate systems and a novel scheme of modular programming is well suited for the nonlinear analysis of turbo-generators and other electro-mechanical energy converters in which both members are slotted. The calculated no-load voltages agree quite well with experimental values, considering that the B-H characteristic has plus or minus 15 per cent tolerances on the H scale. Author (TAB)

N67-24707# Colorado Univ., Boulder. Dept. of Electrical Engineering.

NON-LINEAR ANALYSIS OF HETEROPOLAR ELECTROMECHANICAL ENERGY CONVERTERS. PART I: ANALYSIS OF LARGE DC MACHINES Final Report

Edward A. Erdelyi Aug. 1966 88 p refs
(Contract Nonr-1147(14))
(AD-646370) CFSTI: HC$3.00/MF$0.65

Contents: Analysis in polar coordinates; Summary of the overall analysis procedure, Application of electromagnetic field theory, Assumptions, Grid system, Determination of the initial arrays, The finite difference potential equation, Permeability and reluctance calculations, Boundary conditions, The acceleration of convergence, Calculation of the air gap flux, Motor data and specifications, The computer program, Results, Tables. TAB

N67-24733# Gulton Industries, Inc., Hawthorne, Calif.

A STUDY OF HIGH CURRENT DENSITIES IN NICKEL CADMIUM BIPOLAR BATTERIES Final Report

H. N. Seiger, S. Charlip, A. E. Lyall, and C. Cason (Army Missile Command) Oct. 1966 64 p refs
(Contract DA-01-021-AMC-12509(Z))
(AD-647468) CFSTI: HC$3.00/MF$0.65

Foil type electrodes with 3 mil substrates and 4 mil sinters were developed and assembled into bipolar cells and batteries. Tests were conducted to determine the effects on current and voltage for substrate thickness, sinter thickness, position of end terminals, separator thickness, and plate loading. None of these physical design parameters showed significant effects on the change in current densities. Concentration and activation polarization were the limiting parameters of current density outputs in a bipolar nickel-cadmium battery. Calculated internal impedances were in the range of 1.5 to 3.5 milliohms sq inch. However, experimentally determined internal impedances were 20 times higher. Reference electrode determinations indicate that activation polarization of the negative (cadmium) electrode was the most significant. Activation and concentration polarization of the positive electrode were approximately equal and account for about half of the polarization of the negative. Current densities of 12.5 amperes/sq in were achieved at the maximum power point of 0.6 volts per cell. Author (TAB)

N67-24786# Naval Ordnance Lab., Corona, Calif.

FC-2 LIQUID AMMONIA RESERVE BATTERY. STATUS OF PROTOTYPE STUDY

John C. Daley 1 Nov. 1966 61 p refs
(NOLC-655; AD-646636) CFSTI: HC$3.00/MF$0.65

An investigation was made of the use of the FC-2 Liquid Ammonia Prototype Battery for short-life reserve primary battery applications. The completely self-contained unit, in a volume of 90 cu cm (5.5 cu in.), proved capable of operating for 5 min at a nominal 28 V, 1 A. Performance was satisfactory under simulated missile environments, including shock, vibration, spin, and temperature (-54 to +74C or -65 to +165F). An organic oxidant, m-dinitrobenzene (mDNB), is used as the cell cathode, and the reserve activation feature is provided by storing the electrolyte solvent, anhydrous liquid ammonia, in a separate compartment of the battery case. The basic electrochemical system is Mg/KSCN/NH4SCN-mDNB-C/stainless steel (Type 302). The measured volume energy of this model for a 5 min discharge is 54 J/cu cm (0.1 Wh/cu in.), and weight energy is 20 J/g (2.5 Wh/lb). Author (TAB)

N67-24845# International Business Machines Corp., Oswego, N. Y. Electronics Systems Center.

DIGITAL HYDRAULIC ACTUATOR STUDY Phase III Final Report

G. W. Scott Nov. 1966 100 p refs
(Contract Nonr-4375(00))
(IBM-66-L03-005; AD-647709) CFSTI: HC$3.00/MF$0.65

To further support the practicability of the digital hydraulic actuator as a control component, IBM has successfully demonstrated operation of the Phase III laboratory model in a simulated digital flight control system. Performance using the laboratory model is compared with the performance when using a mathematical model. Recorded transients and the values obtained for a maximum stable step and gain change are presented. The effect of varying the actuator parameters and the validity of a linearized model is also established. Agreement of the results shows the mathematical model to accurately represent the actual hardware. Hence, this study verified the results of both Phase I and Phase II. Author (TAB)

N67-24929# Electric Storage Battery Co., Madison, Wis. Ray-O-Vac Div.

DEVELOPMENT OF MAGNESIUM FLAT CELL BATTERY Second Quarterly Report, 1 Aug.–31 Oct. 1966

Philip F. Albert Ft. Monmouth, N. J., Army Electron. Command. Feb. 1967 37 p
(Contract DA-28-043-AMC-02136(E))
(ECOM-02136-2; AD-647606) CFSTI: HC$3.00/MF$0.65

A second series of five cell stacks was assembled using AZ21X1 magnesium alloy anode plates. The six lots included increased quantities of magnesium bromide and magnesium perchlorate electrolytes, two concentrations of magnesium perchlorate electrolyte and the addition of an organic gum binder in the dry mix in one lot using magnesium perchlorate electrolyte. Initial capacity results (stacks one week old) on this second series are presented on both BA-399 drain and 600 ohms/5-continuous drain tests. Delayed capacity performance on the first series of stacks assembled are given when discharged on the BA-399 drain. The effects of storage time and storage temperature on capacity maintenance and delayed action are given. Author (TAB)

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N67-23535 Joint Publications Research Service, Washington, D. C.
SOVIET RESEARCH IN NUTRITION
17 Feb. 1967 41 p refs Transl. into ENGLISH from two Russian publications
(JPRS-39942; TT-67-30590)

CONTENTS:

1. EXTRACTION OF PROTEINS FROM UNICELLULAR ALGAE N. S. Klyushkina and V. I. Fofanov p 1–9 refs (See N67-23536 12-04)

2. THE USE OF 50 AND 100 GRAMS OF DRY BIOMASS FROM UNICELLULAR ALGAE IN THE HUMAN DIET Yu. I. Kondrat'yev, V. P. Bychkov, A. S. Ushakov, N. N. Boyko, N. S. Klyuskina et al p 10–18 refs (See N67-23537 12-04)

3. THE USE OF 150 GRAMS OF DRY BIOMASS FROM UNICELLULAR ALGAE IN THE HUMAN DIET Yu. I. Kondrat'yev, V. P. Bychkov, A. S. Ushakov, N. N. Boyko, N. S. Klyushkina et al p 19–27 (See N67-23538 12-04)

4. LABORATORY WORK EXPERIENCE OF THE NUTRITIONAL HYGIENE DEPARTMENT OF THE MOSCOW SANITARY EPIDEMIOLOGY STATION S. M. Stremlina and F. M. Mirochnik p 28–31

5. INFANT NUTRITION. ADVICE TO THE YOUNG PHYSICIAN V. Kislyakovskaya and L. Druzhinina p 32–35

N67-23536 Joint Publications Research Service, Washington, D. C.
EXTRACTION OF PROTEINS FROM UNICELLULAR ALGAE
N. S. Klyuskina and V. I. Fofanov *In its* Soviet Research in Nutrition 17 Feb. 1967 p 1–9 refs Transl. into ENGLISH from Vopr. Pitaniya (Moscow), no. 6, 1966 p 3–9 (See N67-23535 12-04)

Studies were conducted to develop an effective semi-production means of breaking down cell membranes of protococcal algae, extracting the maximum protein from the biomass, and obtaining a protein separation along with subsequent testing of its biological value. A 90% breakdown of protococcal algae cells was achieved using a homogenizer with an agitator mixer and polished granules as the disintegrating agent. Proteins were extracted from the disintegrated cells with weak alkali solution and precipitated by acidulation to a pH of 4.5 to 5.0. The protein obtained is twice as digestible as the initial biomass. A four month diet of this protein fed to albino rats provided a positive nitrogen balance, caused no intoxication, and did not affect the generative function of the rats. R.N.A.

N67-23537 Joint Publications Research Service, Washington, D. C.
THE USE OF 50 AND 100 GRAMS OF DRY BIOMASS FROM UNICELLULAR ALGAE IN THE HUMAN DIET
Yu. I. Kondrat'yev, V. P. Bychkov, A. S. Ushakov, N. N. Boyko, N. S. Klyushkina et al *In its* Soviet Research in Nutrition 17 Feb. 1967 p 10–18 refs Transl. into ENGLISH from Vopr. Pitaniya (Moscow), n. 6, 1966 p 9–14 (See N67-23535 12-04)

The effect of a unicellular algae diet on human metabolism was studied. Two groups had 50 and 100 grams of dry algae biomass included in their diets for 22 and 23 days. The diet, consisting of a mixture of Chlorella and Scenedesmus, had no significant effect on the subject's physiological functions, with the exception of lipoid metabolism. The study concludes that up to 100 grams of dry algae biomass can be included in the human diet for a period of 22 days. R.N.A.

N67-23538 Joint Publications Research Service, Washington, D. C.
THE USE OF 150 GRAMS OF DRY BIOMASS FROM UNICELLULAR ALGAE IN THE HUMAN DIET
Yu. I. Kondrat'yev, V. P. Bychkov, A. S. Ushakov, N. N. Boyko, N. S. Klyushkina et al *In its* Soviet Research in Nutrition 17 Feb. 19–27 Transl. into ENGLISH from Vopr. Pitaniya (Moscow), n. 6, 1966 p 14–19 (See N67-23535 12-04)

The effect of a diet containing 150 grams of dry algae biomass on the metabolic processes of the human organism was investigated. Of the five subjects, two received a diet with added unbleached algae biomass while the other three received a diet with added bleached algae biomass. Both control and experimental diets were used. Results showed that the inclusion of 150 grams of either dry bleached or unbleached algae biomass in the human diet led to a number of deviations in the physical condition of most of the subjects, including dyspepsia, edema, rash, and other allergic reactions. Therefore, the 150 gram algae diet is not recommended for humans. R.N.A.

N67-23566# Brown Univ., Providence, R. I.
FURTHER INVESTIGATIONS CONCERNING THE EFFECTS OF COSMIC RAY HEAVY NUCLEI AND OF MICROBEAMS ON MAMMALIAN SKIN Final Summary Report, May 1, 1957–Mar. 31, 1966
Herman B. Chase 19 Sep. 1966 5 p refs
(Contract AT(30-1)-2018)
(NYO-2018-8) CFSTI: HC$3.00/MF$0.65

Work performed during the contract period is summarized. In general the work confirmed the original hypothesis that cosmic ray heavies may have more of a tissue effect than a cellular effect, as predicted on physical grounds, and that there are radiation effects that depend more upon arrangements of cells than upon individual cellular viability. A list of 19 publications resulting from work done under the contract is included. NSA

N67-23625# Army Medical Research Lab., Fort Knox, Ky. Biophysics Div.
HUNGER LEVEL DURING FOOD CONSUMPTION: EFFECTS ON SUBSEQUENT PREFERENCE
Samuel H. Revusky 23 Sep. 1966 12 p refs
(Rept.-681; AD-645207) CFSTI: HC$3.00/MF$0.65

Rats in Group G were fed grape juice while hungry and milk while satiated; Group M was fed milk while hungry and grape juice while satiated. In a subsequent choice between grape juice and milk, Group G preferred grape juice more than Group M. It is theorized that the mechanism responsible for this change in preference is also responsible for the major effects of hunger on performance. Author (TAB)

N67-23628# Stockholm Univ. (Sweden). Dept. of Zoology.
NEURAL MECHANISMS INVOLVED IN INSTINCTIVE BEHAVIOR Final Scientific Report
Eric Fabricius 29 Nov. 1966 22 p refs
(Grant AF-EOAR-65-30)
(AFOSR-67-0097; AD-645298) CFSTI: HC$3.00/MF$0.65

Fear responses were reduced in the pigeon by lesions in the archistriatic region of the forebrain. Pigeons brought up by hand-rearing in isolation from other pigeons subsequently showed sexual responses both to men and to pigeons. Development of fear responses depended on the age at which social contact with parent-substitute was established. Author (TAB)

N67-23720*# National Aeronautics and Space Administration, Washington, D.C.
METABOLIC RATE AND LONGEVITY OF DROSOPHILA. II: THE LONGEVITY AND METABOLIC RATE IN DROSOPHILA MELANOGASTER AT DIFFERENT POPULATION DENSITIES [INTENSIVNOST' OBMENA I PRODO LZHITEL 'NOST' ZHIZNI DROSOPHILA. II. PRODOL' ZHITEL 'NOST' ZHIZNI I INTENSIVNOST' OBMENA U DROSOPHILA MELANOGASTER PRI RAZNOY PLOTNOSTI NASELENIYA]
A. P. Shcherbakov May 1967 8 p refs Transl. into ENGLISH from Arkh. Biol. Nauk, v. 38, no. 3, 1935 p 651–655
(NASA-TT-F-466) CFSTI: HC$3.00/MF$0.65 CSCL 06C

The intensity of oxygen absorption in adult *Drosophila melanogaster* varies with the change in the density of population. With increase of density the intensity of respiration increases. With a density of two flies per vessel (30 cc volume), the absorption of O_2 per hour per gram of weight equals 4.13 cc; with a density of 200 flies respiration increases to 5.16 cc O_2. The intensity of respiration changes much less than the duration of life of the flies according to Pearl. The changes of these two factors have an entirely different character. While the longevity of the flies decreases in both directions from a certain optimal density of population (30–50 flies per vessel), respiration simply increases, though irregularly, with the increasing density. Author

N67-23754# Production Group, United Kingdom Atomic Energy Authority, Annon (Scotland).
TISSUE DOSE-EQUIVALENT RATES. I: FROM COSMIC RAY NEUTRONS. II: IN THE LOW LEVEL ENVIRONMENT OF CHAPELCROSS NUCLEAR POWER STATION
D. E. Watt, D. M. Clare, and A. R. B. Gordon 1966 12 p refs
(PG-734) HMSO: 2s 6d

On the basis of published data from cosmic ray studies, the dose-equivalent rate due to naturally occurring neutron radiation is calculated to be 11.8±1.0 mrem/yr for a small piece of tissue in air at sea level and at a location with geographical coordinates (lat. 55°2'N, long 3°21'W). It is deduced that the neutron dose equivalent experienced by the population at sea level for isotropic irradiation varies from 6.2±0.5 mrem/yr at the surface of the body to 56% of this value at 10 cm deep assuming the body is represented by a semi-infinite slab of tissue 20 cm thick. The dose-equivalent rate at the surface of the body for persons flying at supersonic transport altitudes (65,000 ft) is 0.20±0.02 mrem-hour. Experimental measurements, using the spherical moderator technique, confirm the calculated value for the natural dose-equivalent rate. These measurements were extended to determine contours of dose-equivalence in the low level environment of the reactor installation. It is found that the natural level is not exceeded outside the perimeter fence and that the normal working locations of all employees within the establishment are subjected to neutron dose-equivalent rates well below the maximum permissible recommended by I.C.R.P. In most cases the levels are about five times natural background. Author (NSA)

N67-23789*# National Aeronautics and Space Administration, Washington, D. C.
METABOLIC RATE AND LONGEVITY OF DROSOPHILA. I: INTRODUCTORY REMARKS AND REVIEW OF THE LITERATURE
A. P. Shcherbakov May 1967 17 p refs Transl. into ENGLISH from Arkh. Biologicheskikh Nauk, v. 38, no. 3, 1935 p 639–650
(NASA-TT-F-468) CFSTI: HC$3.00/MF$0.65 CSCL 06C

Summarizing the material regarding the duration of life and the metabolism in Drosophila melanogaster, it is concluded that all the existing material supports the theoretical concepts laid down by Rubner and developed further by E. Bauer. Rubner's constant for normal (wild) Drosophila melanogaster equals approximately 8.7 mg of CO_2 per milligram of weight. This corresponds to 2.5×10^4 calories per 1 kilogram of weight, assuming RQ=0.85. From the fact that the constant proved the same at different temperatures, it follows that within the limits of a certain temperature range (physiologic limits) the longevity is in inverse proportion to the rate of the metabolism, other conditions being equal. The difference in longevity between males and females is related to differences of the metabolism in inverse order. Rubner's constant therefore proves to be the same in both sexes. Author

N67-23822# Washington Univ., St. Louis, Mo. Dept. of Psychology.
SHIFTING AGREEMENT AND DISAGREEMENT IN DYADS UNDER CONDITIONS OF PERCEIVED DIFFERENCES IN TASK COMPETENCE
Richard H. Willis Aug. 1966 24 p refs
(Contract Nonr-816(12))
(AD-641675) CFSTI: HC$3.00/MF$0.65

40 males and 40 females were run in like-sexed dyads in 5 replications of a 2 × 2 × 4 orthogonal design. Independent variables were (a) sex of Ss, (b) direction of difference in perceived task competence, and (c) mode of partner behavior (Conformity, Independence, Anticonformity, Variability). A simulated interaction situation was used in which behavior of partners, as perceived by Ss, was manipulated along two dimensions of response to generate the four modes. Net Conformity and Independence scores were subjected to analysis of variance. Main results: (a) in all but one condition, the unidimensional Conformity-Independence model was applicable; (b) the main effect due to difference in perceived task competence was highly significant and in the expected direction; (c) the interaction between sex of Ss and mode of partner behavior, as measured by Net Conformity scores, was significant, with males and females exhibiting opposite reactions to anticonformity; and (d) the double-clustering of Ss' perceptions of partners, found in a previous experiment on the four modes of behavior but without differences in perceived competence, did not emerge with any consistency. Author (TAB)

N67-23869# Hebrew Univ., Jerusalem (Israel). Dept. of Psychology.
REACTIONS TO STRESS Scientific Report
S. Kugelmass 1 Jan. 1967 90 p refs
(Contract AF 61(052)-839)
(AFOSR-67-0530; AD-647467) CFSTI: HC $3.00/MF $0.65

This report on a series of experiments involves the following research: The influence of blood pressure cuff application on the efficiency of GSR detection; examination of certain biographical correlates of GSR reactivity during experimental lie detection; experimental evaluation of GSR and blood pressure change indices during criminal interrogation; the role of lying in psychophysiological detection; the effect of variation in the mode of stimulus presentation on differential GSR reactivity; identification of variables related to the efficiency of the detection of information within the organism, using a physiological index. TAB

N67-23870# Douglas Aircraft Co., Inc., Huntington Beach, Calif. Advanced Research Lab.

VIRUS GROWTH-GENE REPRESSION HYPOTHESIS OF RADIATION PROTECTION BY AUXIN ANALOGUES

David Norman and Robert D. Schultz (North Am. Aviation, Inc.) Jul. 1966 23 p refs

(Grant NIH PH-43-64-865)

(Douglas Paper-4138; AD-644987) CFSTI: HC $3.00/MF $0.65

A working hypothesis is developed which postulates (1) that death from radiation sickness in mammals is to an appreciable extent the result of the activation of initially latent but potentially cytopathic viruses, and (2) that a radiation-protective auxin analogue blocks such activation by allosterically stabilizing an active form of an auxin-sensitive repressor of a viral gene. The phenomena of lysogeny and virogeny are used as models to develop this hypothesis. Author (TAB)

N67-23927# York Univ., Toronto (Ontario). Molecular Psychobiology Lab.

THE EFFECT OF RNA INJECTIONS ON SHOCK AVOIDANCE CONDITIONING AND ON BRAIN CHEMISTRY

Elizabeth Schaeffer and John Gaito 9 Dec. 1966 28 p refs

(Contract Nonr-4935(00); Grant NRC APB-110)

(MPL-7; AD-645551) CFSTI: HC $3.00/MF $0.65

Two experiments were conducted in which labelled RNA was extracted from shock avoidance trained rats and from untrained rats and subsequently injected into naive rats. There were no meaningful differences in conditioning nor in brain chemical patterns (amount of RNA, DNA, and proteins; ratios of these three; specific activity of RNA and tissue pool fractions, and relative specific activity of RNA fraction) in the recipients as a result of the injections. Author (TAB)

N67-23933# Army Medical Research Lab., Fort Knox, Ky. Biophysics Div.

THE INFLUENCE OF SOME HEXITOLS AND SUGARS ON CO_2 PRODUCTION BY STARVED AND X-IRRADIATED, STARVED YEAST CELLS

Edward S. Spoerl and Ronald J. Doyle 27 Sep. 1966 17 p refs

(Rept.-682; AD-645204) CFSTI: HC $3.00/MF $0.65

Incubation of irradiated and unirradiated yeast cells in solutions of mannitol, ribose, methyl glucose or cellobiose maintained equivalent rates of CO2 production by the two cell types when output was measured with glucose as substrate. This result is in contrast with a relatively higher rate of CO2 output by irradiated cells after a 21 hour incubation in water (starved). Incubation of the cells with the above compounds also eliminated a lag period in CO2 output and preserved a high capacity to produce CO2. On the other hand, incubation with glucose or fructose, though it eliminated the lag, lowered the rate of CO2 output and did not eliminate the difference in output between irradiated and unirradiated cells. Conversion of cells to spheroplasts also eliminated the radiation-induced difference in the rate of CO2 production, and, because sorbitol was used as a stabilizing agent for the spheroplasts, suggested first that sorbitol and other hexitols and sugars be examined. Reincubation, after a 21 hour starvation in water, with any of the compounds tested removed the lag period, though CO2 output was reduced. Author (TAB)

N67-23934# Army Medical Research Lab., Fort Knox, Ky. Experimental Psychology Div.

STIMULUS CHANGE PROPERTIES OF THE RT READY SIGNAL

C. K. Adams and I. Behar 31 Aug. 1966 13 p refs

(Rept.-676; AD-645208) CFSTI: HC $3.00/MF $0.65

Two studies tested the generality of the Perkins-Logan hypothesis in the reaction-time experiment. Both studies used a parametric design with four ambient (intertrial) intensities of white noise ranging from 0 to 90 dB in all combinations with the same four intensities used as ready signals. Direction of change (increase or decrease) from the ambient intensity was significant in one of the two studies, but magnitude of change (30, 60, or 90 dB) produced a highly significant effect in both studies. Author (TAB)

N67-23989 Royal Aircraft Establishment, Farnborough (England). Inst. of Aviation Medicine.

THE INFLUENCE OF ALVEOLAR NITROGEN CONCENTRATION AND ENVIRONMENTAL PRESSURE UPON THE RATE OF GAS ABSORPTION FROM NON-VENTILATED LUNG

J. Ernsting London, Flying Personnel Res. Comm., Jul. 1965 19 p refs

(FPRC/1242)

The airway to the left lung was separated in the anaesthetised dog from the right lung by an endobronchial cannula. After both lungs had respired one of five nitrogen-oxygen mixtures for at least 45 min, the left lung was connected to a bag. The subsequent changes in gas composition in the left lung-bag system and the absorption rate of gas were recordad. Gas absorption proceeded in two phases. In the faster initial phase the composition of the gas in the closed system changed continually, whilst in the final slower phase it remained constant. The rate of absorption in the initial phase was independent of the inspired nitrogen concentration and increased with reduction of environmental pressure. During the final phase the rate of absorption decreased as the inspired nitrogen concentration was raised and the environmental pressure was lowered. Calculations based on these results suggest that the effectiveness of a given inspired concentration of nitrogen in retarding the development of acceleration atelectasis increases as the environmental pressure is reduced. Author

N67-24045# Douglas Aircraft Co., Inc., Huntington Beach, Calif. Advanced Research Lab.

INTERFACE TENSION THEORY OF MUSCULAR CONTRACTION

Alexander F. Metherell May 1966 35 p refs *Its* Res. Commun. No. 10

(Douglas Paper-4037; AD-644981) CFSTI: HC $3.00/MF $0.65

The purpose of this theoretical study is to identify and explain the fundamental source of the forces that cause filament sliding and tension generation during muscular contraction. This paper considers the interface tension in the interface phase of the myoplasmic fluid at the actin and myosin filament boundaries. Because of the geometrical arrangement of the filaments and the localized chemical reactions that are known to take place, gradients occur in the interface tension which cause molecules in the interface phase of the myoplasmic fluid to move parallel to the filaments. The motion at the interface causes viscous shearing in the myoplasmic fluid, which balances the gradient in tension. It is shown that the forces that cause filament sliding and muscular load are the reactions to the viscous shear stresses in the myoplasmic fluid between the overlapping filaments. The velocity of the molecules in the interface phase with respect to the filament is expected to be less than five microns per second, even at maximum physiological effort. This velocity is compatible with motion in close proximity to the solid filaments. This study unexpectedly showed that the contractile load is carriad by the myoplasmic fluid interfaces rather than by the filaments themselves. The stresses in the filaments are always compressive, being in a lower state of compression when the muscle is generating force. Author (TAB)

N67-24056# Webb Associates, Yellow Springs, Ohio. Aerospace Medical Research Dept.

SILICONE SUBMERSION: A FEASIBILITY STUDY

Paul Webb and James F. Annis 21 Oct. 1966 63 p refs

(Contract N62269-3212)

(NADC-MR-6620; Rept.-9; AD-645080) CFSTI: HC $3.00/MF $0.65

The report details a study which demonstrated the feasibility of maintaining men totally and continuously submerged for five days by using silicone fluid in a specially designed tank. Five submersions were tried, 3 were in water for 6 hours for training purposes and 2 were in silicone; one for 16 hours and the final run which lasted a full five days (120 hours) with complete submersion for about 60% of the time and head out immersion for the remaining 40%. It was found that silicone fluid can be used as a weightless simulation medium in prolonged immersion and that subjects can be kept free of skin irritation or maceration for long periods of time if diligent quantity control of the fluid is maintained. It was also found that long submersion need not result in a negative water balance due to diuresis. Author (TAB)

N67-24320*# National Aeronautics and Space Administration, Washington, D. C.
OVERCOMING NEGATIVE EMOTIONS [PREODOLENIYE OTRITSATEL'NYKH EMOTSIY]
K. Ioseliani and Yu. Smirnov Dec. 1966 5 p refs Transl. into ENGLISH from Aviats. i Kosmonavt. (Moscow), no. 9, 1966 p 68–70
(NASA-TT-F-10806) CFSTI: HC$3.00/MF$0.65 CSCL 05J

Methods of controlling the emotional states of pilots in flight are discussed and their importance is emphasized in view of the great nervous and emotional strain associated with piloting modern aircraft and spacecraft. Several methods for self-regulation of emotional states in flight conditions are recommended, including such elementary devices as listening to pleasant sounds and encouraging oneself with phrases like "I can", "I must", etc. Physical exercises, selected for their effect on the muscle groups most fatigued by prolonged static stress, have proved effective. It is further suggested that: (1) Pilots should be familiar with all varieties of breathing exercises, and the physiological and psychological effect of each on the organism (for instance, breathing deeply and exhaling slowly has a calming effect); and pilots should be trained to shift their thoughts at will to pleasant and successful flying experiences, thus overcoming unfavorable emotions arising during flight. Author

N67-24369# Lund Univ. (Sweden).
MONOAMINERGIC MECHANISMS IN NERVOUS TISSUE Final Report, 1 Nov. 1965–31 Oct. 1966
Erik Dahl and Bengt Falck 26 Jan. 1967 15 p refs
(Grant AF-EOAR-66-14)
(AFOSR-67-0531; AD-647401) CFSTI: HC$3.00/MF$0.65

Using the sensitive and specific fluorescence method of FALCK and HILLARP in combination with histochemical methods for cholinesterases, electronmicroscopy and biochemical methods for the localization and estimation of the monoamines, their immediate precursors, and the pertinent enzymes, monoaminergic mechanisms are studies in a broad comparative material. Monoaminergic mechanisms constitute a considerable part in many invertebrate nervous systems and have been studied in detail in numerous species. These studies also led to the finding of a hitherto unknown type of nerve cell i.e. a catecholamine-containing sensory or senso-motoric neuron that has now been localized and mapped out in many species. A comprehensive study on the innervation of the eye and its adnexa has been completed. A characterization of the adrenergic and cholinergic receptors in the hearts of the lamprey and the plaice has been performed. The significance of monoaminergic mechanisms for the development of ventricular fibrillation during induced hypothermia has been extensively studied. A study on adrenergic and cholinergic terminal nervous system has disclosed that such systems may interact probably also by axo-axonatic synapses in several mammalian organs. Author (TAB)

N67-24380# Kansas State Univ., Manhattan. Inst. for Environment Research.
THE CHIMPANZEE A Topical Bibliography
Frederick H. Rohles, Jr. Feb. 1967 77 p refs
(ARL-TR-67-4; AD-647768) CFSTI: HC$3.00/MF$0.65

In June 1962, The Chimpanzee, A Topical Bibliography was published as Aeromedical Research Laboratory Technical Documentary Report (AD-282 661). The first addenda was published in October, 1963, as Aeromedical Research Laboratory Technical Documentary Report (AD-423 068). This report is published as the second addenda and lists 477 new references in chimpanzee research and methodology. Author (TAB)

N67-24401# Stanford Univ., Calif. Dept. of Physiology.
THE DISTRIBUTION OF BLOOD FLOW IN HUMAN SKIN
J. M. Crismon 1 Sep. 1966 56 p refs
(Contract DA-49-193-MD-2311)
(AD-647559) CFSTI: HC$3.00/MF$0.65

Contents: Design, Performance Analysis and Calibration Problems of a Light-weight Capacitance Gauge for Forearm Volume Plethysmography; A Constant-current, Voltage-regulated Control, Calibration and Measuring Circuit for Waggoners High-impedance Elastic Force Gauge; Procedures and Equipment for Measurement of Trans-cutaneous Flux of Helium and Rates of Sweating at Varying Levels of Skin Blood Flow; Clearance of I-131 and Na-22 from Skin in the Presence of Plasma Albumin; The Role of Lymphatics in the clearance of I-131 from Skin Assessed from Clearance Rates of Radio-iodinated Human Serum Albumin; Helium Flux through the Skin of Subjects at 25 plus or minus 2C, with and without Locally-induced Sweating by means of Mecholyl and Pilocarpine Nitrate Iontophoresis; The Effects of General Body Warming, Cooling Posture and Exercise upon Helium Flux through Forearm Skin and upon Total Forearm Blood Flow. Author (TAB)

N67-24410# Library of Congress, Washington, D. C. Aerospace Technology Div.
INDUSTRIAL HYGIENE PROBLEMS OF WORKING WITH ULTRA SHORT-WAVE TRANSMITTERS USED IN TELEVISION AND RADIO BROADCASTING. SURVEYS OF FOREIGN SCIENTIFIC AND TECHNICAL LITERATURE [COPROSY GIGIYENY TRUDA PRI RABOTE S UKV PEREDATCHIKAMI, PRIMENYAYEMYMI V TELEVIDENII I RADIOVESHCHANII]
N. N. Goncharova, V. B. Karamyshev, and N. V. Maksimenko 27 Sep. 1966 125 p refs Transl. into ENGLISH from Gigiena Truda i Prof. Zabolevaniga (Moscow), No. 7, 1966 p 10–13
(ATD-66-125; AD-647687) CFSTI: HC$3.00/MF$0.65

The aim of the research was to study the health aspects of the working conditions of personnel employed in the vicinity of ultrashort-wave television transmitters, and to determine the effects of the electromagnetic fields within these wavelengths. The studies were conducted at radio and television stations whose basic equipment consisted of 2-5 kw transmitters operating at 67-230 Mc. The 16 transmitters studied each consisted of a metal cabinet housing, enclosing power tubes, condensers, oscillators, power line and switching components, and control-and-measuring components. Author (TAB)

N67-24413# Monsanto Research Corp., Everett, Mass.
FACTORS AFFECTING THE EFFICIENCY OF A CHEMICALLY DEFINED DIET Final Report, 15 Jan.–15 Nov. 1966
Yuoh Ku Jan. 1967 50 p refs
(Contract AF 41(609)-2980)
(MRB2038F; AD-647836) CFSTI: HC$3.00/MF$0.65

The retarded growth of rats fed a chemically defined diet has been attributed to the high osmolality of the diet. This investigation was undertaken to study the effect of various carbohydrates on such diets. This idea was based on the premise that the higher molecular weights of certain carbohydrates should reduce the osmolality created by the lower molecular weight of

the amino acids. Results show that when starch was used in these diets, the rats ate more and grew better. In most cases, glucose supported better growth than did sucrose in an amino acid diet. These data do not support the hypothesis of an osmotic effect. The data on stomach emptying pattern revealed that rats fed with starch-amino acid diet empty their stomach contents slower than those receiving amino acid diets containing glucose or sucrose. These data also suggest that the better growth of rats on agar gel diets could be due to the delay in stomach emptying rather than to the water in the diet. Author (TAB)

N67-24416# Southwest Research Inst., San Antonio, Texas.
STUDY OF CALCIUM, PHOSPHORUS, AND NITROGEN MOBILIZATION RESULTING FROM CONDITIONS OF INACTIVITY IN MACACA IRUS MONKEYS
Arthur L. Gross, Kenneth T. Roberson, Louis H. Krough, Jr., and John W. Miesse Nov. 1966 47 p refs
(Contract AF 41(609)-2749)
(SAM-TR-66-94; AD-647617) CFSTI: HC $3.00/MF $0.65

A study was made of calcium, nitrogen, and phosphorus balance resulting during conditions of inactivity. Monkeys, Macaca irus, were inactivated by three different methods: surgical denervation, plaster casts, and tranquilization. The monkeys were placed in the plaster casts either in the sitting position or in the supine position. Balance studies were conducted by measuring food intake and urine and fecal output of calcium, nitrogen, and phosphorus. Calcium was measured by flame photometry, and nitrogen and phosphorus were measured colorimetrically. The animals inactivated by surgical denervation and plaster casts experienced what appeared to be a negative nitrogen balance which could be attributed to disuse atrophy of skeletal muscles. The urinary phosphorus excretion increased in the inactivated animals by severalfold but there was no overall reduction in the total phosphorus excreted. No noticeable changes in calcium balance were observed in the inactivated animals. Author (TAB)

N67-24421*# Fairchild Engine and Airplane Corp., Farmingdale, N. Y.
EFFECT OF DIET AND ATMOSPHERE ON INTESTINAL AND SKIN FLORA. VOLUME I—EXPERIMENTAL DATA
Lorraine S. Gall and Phyllis E. Riely Washington, NASA, Apr. 1967 22 p refs
(Contract NAS9-4172)
(NASA-CR-661) CFSTI: HC $3.00/MF $0.65 CSCL 06P

Aerobic and anaerobic microbiological determinations are reported on human subjects confined for a longer period in an altitude chamber with 100% oxygen. Minimal hygienic procedures with and without space suits and space type diets were observed. The following results were obtained: (1) microorganisms found in each body area and feces were in good agreement with known studies; (2) the total number of colonies increased as the experiment progressed; (3) microflora in the axilla, groin, and glans penis contained staphylococci or micrococci and croynebacteria; streptococci were found in the throat and buccal area; (4) bacterial buildup on body areas related to minimal personal hygiene procedures; (5) isolated potentially pathogenic bacteria did not transfer readily between subjects; (6) in the feces strict anaerobes represented over 95 percent of the predominating bacteria. G.G.

N67-24424# Arbeitsgruppe Biophysikalische Raumforschung, Frankfurt am Main (West Germany).
EXTRATERRESTRIAL BIOPHYSICS AND BIOLOGY [EXTRATERRESTRISCHE BIOPHYSIK UND BIOLOGIE]
[1966] 171 p refs In GERMAN Presented at Frankfurt am Main, 26–27 Oct. 1966; Sponsored by Bundmin. fuer Wiss. forsch.
CFSTI: HC $3.00/MF $0.65

Symposium papers are presented on extraterrestrial biophysics, space factors, closed ecological systems, exobiology, and simulation of space factors. For individual titles, see N67-24424 through N67-24447.

N67-24425# Arbeitsgruppe Biophysikalische Raumforschung, Frankfurt am Main (West Germany).
MOTIVE AND DUTIES OF THE WORK SESSION [MOTIVE UND AUFGABEN DER ARBEITSTAGUNG]
B. Rajewsky *In its* Extraterrest. Biophys. and Biol. [1966] p 5–11 (See N67-24424 12-04)

Biophysical and biological space research activities in West Germany center on technical developments and experiments in biochemistry, biology, and medicine as well as information exchange with the ESRO organization, the USA, and the USSR. Major emphasis is placed on the education of specialists for future experimental verification of interesting problems. Transl. by G.G.

N67-24426# Federal Aviation Agency, Washington, D. C.
BIOLOGICAL EXPERIMENTS IN SPACE OF THE GEMINI PROGRAM, AAP (APOLLO APPLICATIONS PROGRAM) AND AES (APOLLO EXTENSION SYSTEM) [BIOLOGISCHE EXPERIMENTE IM RAHMEN DER PROGRAMME GEMINI, AAP (APOLLO APPLICATIONS PROGRAM) UND AES (APOLLO EXTENSION SYSTEM)]
S. J. Gerathewohl *In* Arbeitsgruppe Biophys. Raumforsch. Extraterrest. Biophys. and Biol [1966] p 15–19 (See N67-24424 12-04)

Large scientific orbiting satellites will be used: (1) as laboratories for investigating physical–biological exchange reactions; (2) as experimental stations for testing regenerative life support systems; (3) as combined experimental stations and laboratories for human clinical assessment; (4) as bases for synoptic studies of terrestrial biology and ecology; (5) as bases for planetary observations in regard to extraterrestrial life; (6) as receiving stations for micrometeorites and connected chemical–biological analyses; (7) as laboratories to investigate pre-biological material; and (8) as planetary quarantine stations. Possible manned scientific missions will study the phenomena of weightlessness, ionizing radiation, ultrahigh vacuum effects, periodicity, and geobiological observations. Transl. by G.G.

N67-24428# Arbeitsgruppe Biophysikalische Raumforschung, Frankfurt am Main (West Germany).
WORK ON COSMIC BIOLOGY IN THE USSR [ARBEITEN UEBER KOSMISCHE BIOLOGIE IN DER UDSSR]
H. Buecker *In its* Extraterrest. Biophys. and Biol. [1966] p 31–36 refs (See N67-24424 12-04)

This summary of extraterrestrial biological research in the USSR gives a brief review of bioscience activities from 1949 through 1966. The first satellite experiments used dogs, monkeys, and rabbits to study acceleration, weightlessness, safety and retrieval factors; later followed a series of dog, mice, and lower biological specimen tests of special life support and flight control systems, radiation and genetic effects, cell physiological changes, and long duration flights. Manned space flights investigated psychological factors of space flight and working conditions outside the spaceship during orbit. The last experimental flights exposed dogs and biological specimen to long duration zero-G and observed the radiation density of the Van Allen belt. Transl. by G.G.

N67-24430# Arbeitsgruppe Biophysikalische Raumforschung, Frankfurt am Main (West Germany).
A FEW RESEARCH PROBLEMS IN EXTRATERRESTIAL BIOPHYSICS, ESPECIALLY THE EFFECTS OF SPACE FACTORS [EINIGE FORSCHUNGSPROBLEME DER EXTRATERRESTRISCHEN BIOPHYSIK, INSBESONDERE DER WIRKUNG VON RAUMFAKTOREN]
Horst Buecker *In its* Extraterrest. Biophys. and Biol. [1966] p 45–50 (See N67-24424 12-04)

Biophysical factors of the extraterrestrial environment can be used to study the physical and chemical laws of our ecology and to form a basis for effective shielding of living organic systems during space flight. Considered are weightlessness effects on sensory-psychological processes and possible circulatory disturbances, pressure variations in the otolytic apparatus, and specific changes in the metabolism of the biological cell. Reactions to extraterrestrial ultraviolet radiation and ionization can be monitored with the help of a luciferin-luciferase fermentation reaction with its high sensitivity to radiation effects. Transl. by G.G.

N67-24431# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Bad Godesberg (West Germany). Institut fuer Flugmedizin.

BIOLOGICAL PROBLEMS OF WEIGHTLESSNESS [BIOLOGISCHE PROBLEME DER SCHWERELOSIGKEIT]

W. Briegleb *In* Arbeitsgruppe Biophys. Raumforsch. Extraterrest. Biophys. and Biol. [1966] p 51–58 (See N67-24424 12-04)

The importance of physiological weightlessness as environmental factor in formation and function of the live plasma, and thus for biological organism, is outlined. Possible simulation techniques for biological weightlessness studies include specimen rotation vertical to the direction of gravity, free fall, and acceleration of fluid combinations of little affinity and differing weights. The latter method leads to the formation of sliding boundary layers that can be utilized to represent formation and motion of jellyfish. The primary reaction of georeceptors in plants is attributed to shifting of amyloplasts and mitochondria in the cell. Transl. by G.G.

N67-24434# Medizinischen Akademie, Luebeck (West Germany).

THE RENAL SECRETION OF 17-KETOSTEROIDS. ON THE QUESTION OF CORTICOSTEROID CHANGES BY STRESS ACTION [DIE RENALE AUSSCHEIDUNG VON 17-KETO-STEROIDEN. ZUR FRAGE DER CORTICOSTEROID VERAEN-DERUNGEN NACH STRESS-EINWIRKUNG]

H. Schreiber *In* Arbeitsgruppe Biophys. Raumforsch. Extraterrest. Biophys. and Biol. [1966] p 75–78 refs (See N67-24424 12-04)

Renal elimination of corticosteroids during space flight is attributed to optical radiation energy and its impact on the terminal vegetative nerve elements of the skin. Transmittal of the irritation signal to the cortex pituitary regulation center in turn initiates the general biological leucocyte reaction regarded as adaptation syndrome and thus leads to the stress related increased production of steroid hormones. Transl. by G.G.

N67-24437# Phillipps-Universitat, Marburg (West Germany). Institut fuer Angewandte Physiologie.

PROBLEMS OF OXYGEN SUPPLY UNDER VARIOUS OXYGEN PRESSURES OF THE ENVIRONMENT [PROBLEME DER SAUERSTOFFVERSORGUNG BEI VERSCHIEDENEN SAUERSTOFFDRUCKEN DER UMGEBUNG]

D. W. Luebbers *In* Arbeitsgruppe Biophys. Raumforsch. Extraterrest. Biophys. and Biol. [1966] p 95–104 refs (See N67-24424 12-04)

Energy production by mitochondria depends on their phosphorization potential; decreased oxygen pressure and lower breathing rates reduce the blood supply to the mitochondria and thus the capillary diffusion pressure. The effective critical oxygen pressure in organs is related to its specific capillary structure, the breathing volume, and the concentration of breathing ferments. Capillary structures and corresponding dimensional distribution of energy conversion and atom chain concentration represent together a particular optimization. Transl. by G.G.

N67-24438# Phillipps-Universitat, Marburg (West Germany). Institut fuer Arbeitsphysiologie.

CROSSED ADAPTABILITY BETWEEN BODILY TRAINING AND HIGH TOLERANCE [GEKREUZTE ANPASSUNG ZWISCHEN KOERPERLICHEM TRAINING UND HOEHENTOLERANZ]

E. Voigt *In* Arbeitsgruppe Biophys. Raumforsch. Extraterrest. Biophys. and Biol. [1966] p 105–106 (See N67-24424 12-04)

Blood chemical reactions of training athletes, exposed to an oxygen deficient atmosphere of 6900 m, gave the following results: plasma corticoid levels increased markedly during stress, in highly trained persons even more than in untrained subjects. Return to normal level started shortly after a resting position was assumed, but the normal unstressed corticoid level was always higher in trained subjects than in normal, untrained subjects. Transl. by G.G.

N67-24439# Max-Planck-Institut fur Biophysik, Frankfurt am Main (West Germany).

CHEMICAL EVOLUTION AND ORIGIN OF LIFE [CHEMISCHE EVOLUTION UND URSPRUNG DES LEBENS]

Klaus Dose *In* Arbeitsgruppe Biophys. Raumforsch. Extraterrest. Biophys. and Biol. [1966] p 109–117 refs (See N67-24424 12-04)

Biological evolution and the development of an atmosphere on earth are analyzed by projecting cosmic-chemical and biological-chemical reactions. Possible energy sources for a chemical evolution 4.5×10^9 years ago constitute ultraviolet radiation effects below 4000 Å, ionizing radiation of the earth mantle, electrical discharge, and vulcanic thermodynamic processes. Laboratory experiments demonstrate the chemical evolution of amino acids and other biological derivatives of aliphatic carbon hydrates directly from primitive atmospheres. Reported also are syntheses of polynucleoids from nucleoids in the presence of metaphosphates; fractionation of high polymers obtained from vulcanic lava gave some slightly enzymatic products. Transl. by G.G.

N67-24440# Phillipps-Universitat, Marburg (West Germany). Institut fuer Kernchemie.

CHEMICAL ANALYSIS OF PLANET SURFACES THROUGH LAND ROCKETS—THEIR MEANING FOR THE SEARCH FOR EXTRATERRESTRIAL LIFE [CHEMISCHE ANALYSE VON PLANETENOBERFLAECHEN DURCH LANDSONDEN—IHRE BEDEUTUNG FUER DIE ERFORSCHUNG EXTRATER-RESTRISCHEN LEGENS]

Diether Schmidt *In* Arbeitsgruppe Biophys. Raumforsch. Extraterrest. Biophys. and Biol. [1966] p 119–123 (See N67-24424 12-04)

This survey contains the most important analytical methods to obtain chemical data on planetary surfaces by unmanned sounding and landing probes. Depicted chemical analyses for exobiological important organic substances include gas chromatographic methods and differential thermoanalysis. Proposed analytical methods are shown in table form in order of increased complexity with regard to exobiological factors. Transl. by G.G.

N67-24442# Arbeitsgruppe Biophysikalische Raumforschung, Frankfurt am Main (West Germany).

POSING THE PROBLEM OF BIOPHYSICAL SIMULATION CHAMBERS [PROBLEMSTELLUNGEN FUER BIOPHYSIKA-LISCHE SIMULATIONSKAMMERN]

Horst Buecker *In its* Extraterrest. Biophys. and Biol. [1966] p 129–133 refs (See N67-24424 12-11)

Ultrahigh vacuum chambers were utilized to simulate space factors for exobiological research. Experimental results with fungus spores established their high resistance; a 10 to 30% damage effect in germination did not increase after the first 5 minutes of exposure to 10^{-6} Torr. Various bacteria that form spores were

not adversely affected by the high vacuum but their life lengths increased in contrast with controls. Other bacteria showed a 30% decrease in life expectancy. Fungus spores and myzetes were also not affected by the high vacuum. Transl. by G.G.

N67-24444# Leybolds (E.) Nachfolger, Cologne (West Germany).
ERECTION OF APPARATUS WITH THE BIOLOGICAL OBJECT OF SETTING UP THE CONDITIONS OF SPACE [AUFBAU VON APPARATUREN, IN DENEN BIOLOGISCHE OBJEKTE DEN BEDINGUNGEN DES WELTRAUMS AUSGESETZT WERDEN KOENNEN]
J. Moll *In* Arbeitsgruppe Biophys. Raumforsch. Extraterrest. Biophys. and Biol. [1966] p 141–143 (See N67-24424 12-11)

Investigation of biological objects under simulated space conditions requires definition of the following parameters: (1) time history of the degassing process in the vacuum chamber and possible termination at desired pressure; (2) determination and control of gaseous combination and vapor in the vacuum; (3) temperature determination of specimens during experiments; (4) measurements of characteristic parameters during the evacuation process; (5) instrumentation for possible exchange of samples in the chamber; (6) sample observation and radiation effects; and 7) a partial pressure analysis in the vicinity of samples. Transl. by G.G.

N67-24450*# National Aeronautics and Space Administration, Washington, D. C.
INTOXICATION BY HIGH OXYGEN PRESSURES [DE L'INTOXICATION PAR LES HAUTES PRESSIONS D'OXYGENE]
C. Hederer and L. Andre Feb. 1967 16 p ref Transl. into ENGLISH from Bull. Acad. Natl. Med. (Paris), v. 123, 1940 p 294–308
(NASA-TT-F-10758) CFSTI: HC $3.00/MF $0.65 CSCL 06S

The intoxication by oxygen at high pressure, specifically with respect to the physiopathological problems in submarine operation and deep-sea diving, was investigated on rabbits in a caisson at oxygen pressures ranging from normal to 6 atm abs. The poisoning, representing an association of clonic and tonic convulsions, is a reversible phenomenon which largely obeys the law of mass action. Younger experimental animals showed greater resistance than older subjects; fasting has a protective function by increasing the resistance of the individual; an organism sensitized by a first attack was more vulnerable to repeated oxygen exposure; carbon dioxide present in small amounts in the oxygen always led to morbid accidents; barbiturates, by exerting an antagonistic action, retarded, attenuated, and even prevented convulsions but not the fatal outcome. Author

N67-24487# Library of Congress, Washington, D. C. Aerospace Technology Div.
CBE FACTORS Monthly Survey No. 13
1967 223 p refs
(ATD-67-4; TT-67-61113; AD-647668) CFSTI: HC $3.00/MF $0.65

The monthly survey is based on Communist World open sources. It is the thirteenth in a series of monthly surveys covering the following areas: I. Chemical factors (pesticides, herbicides, fertilizers, psychotomimetics, other chemicals); II. Biological factors (pathogens); III. Environmental factors (aerosols, ecology, micrometeorology, soil science). Author (TAB)

N67-24566# Battelle-Northwest, Richland, Wash.
NEUTRON DOSIMETRY USING THE FISSION FRAGMENT DAMAGE PRINCIPLE
W. V. Baumgartner and L. W. Brackenbush Dec. 1966 15 p refs
(Contract AT(45-1)-1830)
(BNWL-332) CFSTI: HC $3.00/MF $0.65

Data are given on the developments to incorporate the fission fragment damage principle into a personnel neutron dosimeter. Plastic, glass, and minerals used in conjunction with fissionable materials (^{235}U and ^{237}Np) provide the basis for a full energy spectrum neutron dosimeter. Prototype dosimeter results show marked improvement in dose response when compared to nuclear track emulsions neutron dosimeters. The fission fragment neutron dosimeters permitted dose evaluation in several neutron energy groups in mixed gamma and neutron radiation fields. Theoretical and experimental studies indicate that fast neutron doses as low as 150 mrem and thermal neutron doses of 1 mrem can be measured. NSA

N67-24582 Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Bad Godesberg (West Germany).
FUNCTIONAL TESTS OF THE KIDNEYS UNDER HIGH PRESSURE [NIERENFUNKTIONSPROBEN IM UBERDRUCK]
H.-H. Knapp Jan. 1967 41 p refs In GERMAN; ENGLISH summary
(DLR-FB-67-01)

Six male subjects were exposed to Clearance experiments under normal as well as under high pressure. The high-pressure tests were performed in a pressure chamber of a volume of 9 m^3. The subjects were younger people with an average age of 24 years. The tests should clear the question whether modifications of renal function may arise during an exposure of 2–3 hours to high pressure. The tests were restricted on the PAH-Inulin-Clearance and the Phenolred-test. During the increase of the glomerulum filtration-rate a significant reduction of the blood circulation of the kidneys was found. In four cases a reduction of the tubular excretion ability was found. Author

N67-24589 Royal Aircraft Establishment, Farnborough (England). Inst. of Aviation Medicine
MEASUREMENT OF REGIONAL PULMONARY BLOOD VOLUME USING 125 I-POLYVINYLPYRROLIDONE
D. H. Glaister London, Flying Personnel Res. Comm., Jul. 1965 23 p refs
(FPRC/1241) CFSTI: HC $3.00/MF $0.65

Existing methods for the measurement of the quantity of blood in the lungs are discussed and their results compared. Most measure varying fractions of the central blood volume in addition to blood within the lung parenchyma. A new technique is described which allows not only the specific determination of lung blood content but also measurement of its distribution within the lung, and of the time course of any changes which take place. The circulating blood is labelled with iodine-125 tagged polyvinylpyrrolidone and the distribution of radioactivity in the lung fields is determined by external scintillation counting. The counters are calibrated using a specially developed lung phantom to give blood content in terms of $\mu l/gm$ of lung tissue. The technique is evaluated by studying the effects of posture, passive alteration from supine to sitting causing a reduction in total lung blood content of 54 percent, the decrease being more marked in the upper lung than in the lower lung. These changes were completed within 15 sec of the alteration in posture. The effect of a Valsalva maneuver on regional lung blood content is also described. Author

N67-24650# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SENSORY COGNITION
F. I. Georgiyev, V. I. Dubovskoy et al 31 Oct. 1966 259 p refs Transl. into ENGLISH of the book "Chuvstvennoye Poznaniye" Moscow, Izd. Mosk. Univ., 1965 p 1–237
(FTD-HT-66-431; TT-67-60991; AD-646929) CFSTI: HC $3.00/MF $0.65

Gnosiological analysis was made of the basic forms of sensory cognition-sensation, perception, and ideation. One of the central topics is the problem of adequacy of sensory cognition, particularly sensations and perceptions. Sensations, perceptions, and

ideas are considered to be subjective images of reality and not symbols. The character of images produced by sensory cognition is affected by conditions under which the object reflected exists, the structure and activity of the individuals sense organs, etc. The relationship of images, symbols, and signals is discussed and the relationship of images and models is elucidated. Author (TAB)

N67-24659# North Carolina Univ., Chapel Hill. Dept. of Physiology.

HYPOTHERMIA AND BLOOD FLOW THROUGH SKELETAL MUSCLE, SEPTEMBER 1, 1958–AUGUST 31, 1965

Lloyd R. Yonce 31 Aug. 1966 53 p refs

(Contract DA-49-007-MD-1002)

(AD-647495) CFSTI: HC $3.00/MF $0.65

The effect of hypothermia on the circulation of skeletal muscle was studied. All experiments utilized the gracilis muscle of the dog. The rate of production of hypothermia determines the vascular response, a fast rate (> 1C/min) causing vasodilatation and a slow rate (< 1C/min) causing vasoconstriction. The oxygen uptake is decreased by temperature but is independent of the rate of production of hypothermia. The vascular response is well correlated with the pO2 of the venous blood (determined from the oxygen dissociation curve) whether the temperature is lowered rapidly or slowly. This suggests either a direct or indirect relationship between aerobic metabolism and vasomotor activity. The reactivity of the blood vessel, as indicated by reactive hyperemia, decreased during hypothermia but the rate of recovery of reactive hyperemia is independent of the temperature change and dependent on the rate of temperature change. This means that the time for recovery from reactive hyperemia is determined by the effect of hypothermia on the control blood flow. Author (TAB)

N67-24667# India. Dept. of Atomic Energy, Bombay. Biology Div.

STUDIES ON PRIMARY RADIATION DAMAGE AND MECHANISM OF RADIOSENSITIVITY Progress Report, Apr. 1–Dec. 31, 1965

31 Dec. 1965 15 p

(Contract IAEA-187/RB)

(NP-16209; PR-5) CFSTI: HC $3.00/MF $0.65

Studies are reported on: the effects of glycerol on free radical reactions in irradiated trypsin, and reactions of OH radicals with nucleic acid bases and some amino acids and proteins; and the dose response in adenine, thymine, and uracil and also in the equimolecular complexes of adenine-thymine and adenine-uracil. Trypsin was freeze-dried from aqueous solution that contained 15% glycerol by weight of the protein present. After irradiation and observation at 77°K, the ESR spectrum showed an asymmetrical line and no radicals due to glycerol were obtained. At room temperature Ch_2S radicals and doublet signal were found to grow as usual. Experiments have indicated that the free radical yield of the adenine-thymine complex is less than the sum of the yields of the two constituents on an equimolecular basis while that of the adenine-uracil complex is more beyond a certain dose. . . NSA

N67-24721# Imperial Coll. of Science and Technology, London (England). Dept. of Electrical Engineering.

NEURONAL NETS

Jack D. Cowan Jul. 1966 72 p refs

(Contract N62558-4256)

(AD-646624) CFSTI: HC $3.00/MF $0.65

Contents: The Neuron; Neuronal Nets: the electroencephalogram; electrocorticograms and evoked responses; microelectrode recordings and slow potentials; functional aspects of nets. TAB

N67-24725# Army Medical Research and Nutrition Lab., Denver, Colo. Fitzsimons General Hospital.

RESPIRATORY FUNCTION IN NORMAL YOUNG ADULTS AT 3475 AND 4300 METERS, OCTOBER 1964–FEBRUARY 1965

C. Frank Consolazio, Herman L. Johnson, LeRoy O. Matoush, Richard A. Nelson, Gerhard J. Isaac et al 5 Jan. 1967 32 p refs

(USAMRNL-300; AD-646481) CFSTI: HC $3.00/MF $0.65

The respiratory function of two groups of normal, young adults were studied at altitudes of 3475 and 4300 meters for 21 and 28 days, respectively. In the 4300 meter study, physical conditioning in one-half of the subjects proved to be beneficial since it resulted in an additional increase in Maximal breathing capacity (MBC) during high altitude exposure. This suggests that physical conditioning may be a factor in assessing a superior physical condition at altitude. Maximal breath holding times, at altitude, were also significantly increased with physical conditioning. For the combined groups, the MBC were all significantly increased at high altitude, which was not apparent in the sea level group. This may have been due to the decreased work of breathing the rarefied air at altitude. Maximal breath holding times were significantly decreased for all groups during high altitude exposure, and forced vital capacities (FVCs) in general were decreased at altitude. The sea level controls showed no changes in MBC, FVC, and maximal breath holding time during the entire study. Author (TAB)

N67-24731# Naval Medical Research Inst., Bethesda, Md.

THE RELATIONSHIP OF SCUBA DIVING TO THE DEVELOPMENT OF AVIATORS' DECOMPRESSION SICKNESS Research Report

Donald E. Furry, Elizabeth Reeves, and Ed Beckman Dec. 1966 17 p refs

(MF-011-99-1001; Rept.-5; AD-646494) CFSTI: HC $3.00/MF $0.65

The additional decrease in ambient pressure which occurs when a compressed air diver flies in an aircraft within a short time after diving may be sufficient to precipitate decompression sickness, even though the dive itself was in accordance with the U. S. Navy decompression tables. The current practice by both military and civilian divers of using air transportation after compressed air diving suggests the need for specific instructions regarding the decompression required before flying after diving. In order to quantitate the importance of this problem, an experiment was designed in which large dogs were exposed to compressed air for 7 hours at their no-bends pressure threshold as determined after the method of Reeves and Beckman. After pressurization, the animals were decompressed within 2–3 minutes to sea level. A sea level decompression interval of 1, 3, 6, or 12 hours was given prior to further decompression to a simulated altitude of 10,000 feet. The incidence of decompression sickness at altitude was 92.9% for the 1 hour surface decompression interval, 30% for the 3 hour interval, 27.8% for the 6 hour interval and 0% for the 12 hour interval. From these large animal studies it may be postulated that a surface decompression interval of at least 12 hours should be allowed before flying after compressed air diving of a depth and duration to require the use of diving tables. TAB

N67-24748# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

OXYGEN DEFICIENCY AND AGE

A. Z. Kolchinskaya 23 May 1966 348 p refs Transl. into ENGLISH of the book "Nedostatok Kisloroda i Vozrast" Kiev, Izd. Naukova Dumka, 1964 p 1–336

(FTD-MT-65-222; AD-646963) CFSTI: HC $3.00/MF $0.65

The monograph is dedicated to questions of the action of deficiency of oxygen in inhaled air on the human organism in various stages of its growth. It described age-connected peculiarities of changes of higher nervous activity, external breathing, blood

circulation, level of saturation of arterial blood with oxygen, and consumption of oxygen in an atmosphere with a lowered partial pressure of oxygen during inhalation of mixtures poor in oxygen, during rarefaction of air in a pressure chamber, in alpine conditions. Author (TAB)

N67-24764# Cincinnati Univ., Ohio. Coll. of Medicine.
METABOLIC CHANGES IN HUMANS FOLLOWING TOTAL-BODY IRRADIATION Summary Report, Feb. 1960–Apr. 30, 1966
Eugene L. Saenger, Ben I. Friedman, James G. Kereiakes, and Harold Perry 30 Apr. 1966 174 p refs
(Contract DA-49-146-XAZ-315)
(DASA-1844; AD-646667) CFSTI: HC $3.00/MF $0.65

This report summarizes the data accumulated from fifty patients who have been given total or partial body irradiation at the University of Cincinnati Medical Center from February 1960 through April 1966. Psychological, hematological, metabolic, immunological and chromosomal findings are statistically analyzed and some implications concerning reduction in combat effectiveness of military personnel exposed to ionizing radiation are drawn. TAB

N67-24777# York Univ., Toronto (Ontario). Molecular Psychobiology Lab.
MOLECULAR NEUROCHEMISTRY OF THE HIPPOCAMPUS AND OTHER BRAIN SITES DURING CONDITIONED AVOIDANCE BEHAVIOR
John Gaito, James H. Davison, James Mottin, and Joanne Rigler 5 Jan. 1967 21 p refs
(Contract Nonr-4935(00); Grant NRC APB-110)
(MPL-8; AD-646701) CFSTI: HC $3.00/MF $0.65

Two experiments were conducted to evaluate neurochemical changes in the ventral hippocampus of rats in a one way active avoidance conditioning task. The dependent variables were amounts of RNA, DNA, and proteins; ratios of these three; the specific activity of protein and tissue pool fractions; and the relative specific activity of the protein fraction. In these experiments a lower shock level was used than in previous experiments. The learning animals showed a tendency to greater specific activity of TCA and protein fractions and to a greater relative specific activity of the protein fraction in brain tissue than did non-learning animals. The results concerning individual brain tissues suggested that the medial ventral cortex, and possibly the posterior ventral cortex, may be involved in this type of learning. No significant differences were found in the ventral hippocampus. Author (TAB)

N67-24810# School of Aerospace Medicine, Brooks AFB, Tex.
THE EFFECT OF CHEMICALLY INERT GASES ON OXYGEN CONSUMPTION IN LIVING TISSUES Interim Report, Jan.–Dec. 1965
Domenic A. Maio and J. Ryan Neville Dec. 1966 23 p refs
(SAM-TR-66-109; AD-647808) CFSTI: HC $3.00/MF $0.65

The effect of N2, He, and A at normal pressures (approx. 560 mm. Hg) on the oxygen consumption of yeast cells, rat liver slices, and rat liver homogenates was studied. By utilizing both polarographic and Warburg technics, comparisons were made between 20% O2 - 80% inert gas mixtures and 100% O2. A consistent but small depression of oxygen consumption of yeast in the presence of inert gases was noted with the dropping mercury electrode. No effect of changing oxygen tension was apparent except below the critical oxygen tension (4 or 5 mm. Hg). With the Warburg technic, oxygen consumption of liver slices in inert gas mixtures was found to decrease as much as 60% compared to pure oxygen controls. Small but apparently insignificant differences in this depressive effect were noted between the inert gases. Manipulation of both shaking rate and temperature indicated that physical diffusion of oxygen was not a limiting factor. The rate of oxygen consumption by rat liver slices was found to be a constant regardless of oxygen tension throughout the range studied. Homogenates of rat liver tissue failed to display this depression in the presence of inert gas, oxygen consumption being identical to that for pure oxygen controls. This would seem to indicate that the site of the depressant action may be in the cell membrane and that the inert gas may possibly act on a membrane mechanism for oxygen transport into the cell. Author (TAB)

N67-24817# Army Medical Research Lab., Fort Knox, Ky. Experimental Psychology Div.
EXPLORATORY STUDY OF THE EFFECT OF PULSE DURATION ON TEMPORARY THRESHOLD SHIFT PRODUCED BY IMPULSE NOISE Final Report
John L. Fletcher and Michel Loeb Jan. 1967 18 p refs
(Rept.-680; AD-647540) CFSTI: HC $3.00/MF $0.65

Human Ss were exposed to a series of impulses of variable duration. Pre- and post-exposure hearing was examined to determine the differential effect of pulse duration on temporary threshold shift. An apparently linear duration effect was observed. Author (TAB)

N67-24833# Federal Aviation Agency, Oklahoma City, Okla.
EXPOSURE OF MEN TO INTERMITTENT PHOTIC STIMULATION UNDER SIMULATOR IFR CONDITIONS
C. E. Melton, E. A. Higgins, J. T. Saldivar, and S. Marlene Wicks Oct. 1966 14 p refs
(FAA-AM-66-39; AD-646872) CFSTI: HC $3.00/MF $0.65

Ten men were subjected to intermittent photic stimulation in an airplane cockpit in an environmental chamber by (1) a Grimes red rotating beacon (1.5 FPS), (2) an Air Guard strobe light (1.0 FPS) and (3) propeller flicker (10 FPS). IFR conditions were simulated by passing steam into the cooled chamber. Electroencephalograms and electrooculograms were recorded for the 10 minute period prior to photic stimulation, during 10 minutes of photic stimulation, and for 10 minutes after stimulation. None of the lights provoked seizure, syncope, nystagmus or photic driving. The strobe light evoked complaints of irritation from 7 of the subjects and caused pacing of the alpha rhythm together with pulsating pupils. Three subjects became drowsy during the Grimes light, six became drowsy during propeller flicker, none complained of drowsiness during the strobe light. These sources of intermittent light appear to be innocuous to normal people. The commonest complaint was annoyance. Drowsiness was probably due to the environment and nature of the task. TAB

N67-24856# North American Aviation, Inc., El Segundo, Calif. Life Sciences Operations.
MARSUPIAL BIOMODULE EVALUATION STUDY Final Report, 1 Nov. 1965–31 Oct. 1966
Peter R. Barker, Hyman C. Bergman, William H. Hunter, William H. Lawrence, Cecil W. Steers et al Feb. 1967 105 p refs
(Contract AF 41(609)-2984)
(SID-66-1647; AMD-TR-66-3; AD-647844) CFSTI: HC $3.00/MF $0.65

Experiments were conducted involving the maintenance of opossum Didelphys virginiana postpartum embryos in an artificial marsupium (laboratory biomodule) during the period that they normally remain attached to the maternal teats. Areas investigated were laboratory biomodule life-support cells simulating the pouch environment; diet formulation and analysis of opossum milk; development of artificial nipples and nutrient dispensing systems, histology studies of the embryo attachment to the maternal teat; methods of monitoring physiological parameters by nonattached sensors; and the feasibility of a field-sequential television camera system to produce color photographs of small animals, such as opossum embryos, of a quality that would assist in remotely monitoring their development. Several laboratory biomodule configurations and nutrient dispensing systems, in combination with many nutrient formulations and nipple assemblies, were used to maintain the embryos studied in this program in the biomodules.

Their mean survival time was approximately 67 hours, and the longest survival time being approximately 19 days. Limited testing demonstrated the capability to monitor respiration rate and gross body motion with nonattached sensors. A television camera system produced good-quality color photographs of immature rats. A specification for a field-sequential television camera system, suitable for use in a spacecraft, was prepared. Author (TAB)

N67-24890# Army Medical Research Lab., Fort Knox, Ky.
SOME STATISTICAL TREATMENTS COMPATIBLE WITH INDIVIDUAL ORGANISM METHODOLOGY Final Report
Samuel H. Revusky 21 Feb. 1967 49 p refs
(USAMRL-716; AD-646751) CFSTI: HC $3.00/MF $0.65

Consider experimental treatments with consequences so irreversible that baseline performance cannot be recovered. The conventional method of assessing the effects of such treatments by statistical means involves separate experimental and control groups. An alternative proposed here is to administer the experimental treatment to each subject, one subject at a time and in a random order; whenever any subject receives the experimental treatment, those subjects which have not yet received it receive a control treatment. This procedure permits results significant at the one-tailed .05 level to be obtained with four subjects; if a two-group procedure evaluated by means of the U test is used, a minimum of six subjects is needed for the same significance level. Author (TAB)

N67-24895# Parma Univ. (Italy). Inst. of Human Physiology.
PROCESSING OF SENSORY VISUAL INFORMATION Final Report, 1 Jan.–31 Dec. 1966
Arnaldo Arduini 31 Jan. 1967 46 p refs
(Grant AF-EOAR-66-26)
(AFOSR-67-0403; AD-647119) CFSTI: HC $3.00/MF $0.65

Microelectrode investigations in the central visual pathways under Nembutal anesthesia demonstrated that the type of tonic response to illumination depends on the level of the impulse firing rate during dark adaptation. Micro- and macroelectrode researches in the pretrigeminal preparations seem to substantiate these results and prompted an investigation of the possibility of modifying the level of discharge of the retina in darkness in a light-independent way. The results were positive. Microelectrode investigations on the pretectal region were performed with the purpose of describing the processing of visual information which is at the base of the sensory-motor integration in the pupil-motor structures. Author (TAB)

N67-24949# Naval Air Development Center, Johnsville, Pa.
FURTHER OBSERVATIONS ON CHRONIC DEFICITS OF TEMPERATURE REGULATION PRODUCED IN CATS BY PREOPTIC LESIONS
Russell D. Squires 16 Dec. 1966 52 p refs
(NADC-MR-6626; Rept.-34; AD-647357) CFSTI: HC $3.00/MF $0.65

Destruction (by electrolysis) of a small region extending at least 0.5 mm either side of the midsagittal plane of the preoptic region of the hypothalamus of cats led to sustained, significant decrease of mean daily colonic temperature as long as the animals were undisturbed at ambient temperatures of 19 to 27 C. Exposure of such animals to unfamiliar surroundings, handling, physical restraint, local cooling of the skin, or cold (0 to -5 C) ambient temperatures produced a rise in colinic temperature accompanied by palpable shivering, which was absent as long as the animals were undisturbed. When the same animals were subjected to high (40 C) ambient temperatures, their previously subnormal colonic temperatures rose to levels higher than those of unoperated control animals similarly exposed, while panting was observed in both. Lesions of the same general region which tended to spare the medial preoptic region were often associated with initial hyperthermia, which sometimes gave way to delayed hypothermia. An initial hypothermia following a bilateral medial preoptic lesion, however, never gave way to delayed hyperthermia. It is therefore suggested that the initial hyperthermia could have been due to inflammatory irritation of the medial preoptic region, and that the subsequent hypothermia was the result of progression of the inflammatory process to the point of destruction of a critical amount of medial preoptic tissue. These findings indicate that the preoptic region of the cats hypothalamus contains structures sensitive to both heat and cold, therefore to changes in blood temperature in either direction. Author (TAB)

N67-24988# Lyon Univ. (France).
MONOAMINES AND SLEEP; POLYGRAPHIC, NEUROPHARMACOLOGICAL AND HISTOCHEMICAL STUDY OF SLEEP IN THE CAT [MONOAMINES ET SOMMEILS; ETUDE POLYGRAPHIQUE, NEUROPHARMACOLOGIQUE ET HISTOCHIMIQUE DES ESTATS DE SOMMEIL CHEZ LE CHAT]
Francois Delorme Dec. 1966 177 p refs In FRENCH
(Grant AF-EOAR-66-64)
(AFOSR-67-0511; AD-647397) CFSTI: HC $3.00/MF $0.65

The neurophysiological aspects of the sleep mechanism are reviewed. Electroencephalo-polygraphic tracings of a normal adult cat were analyzed for the state of wakefulness, and the influence of sleep-inhibiting drugs. The pharmacological and histological effects of the following agents on paradoxical sleep were considered: serotinin, reserpin, catecholamine, and monoamine oxydase. A table compares the action of various drugs administered during laboratory experimentation on the cat. An extensive bibliography is also included. Transl. by R.Li.

N67-25000# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
TEMPERATURE CONTROL OF THE ORBITAL OTOLITH EXPERIMENT
Paul R. Schrantz May 1966 75 p refs
(Contract NOw-62-0604-c)
(APL-TG-815; AD-646921) CFSTI: HC $3.00/MF $0.65

This report presents a description of the temperature control system that has been developed for the Orbital Otolith Experiment. The experiment has been packaged in a cylindrical vessel which will be installed in one of the first manned Apollo vehicles. A water supply in which two frogs are submerged must be maintained at 65 plus or minus 5 F for approximately 100 hours in orbit. The thermal design approach has been to thermally isolate the capsule from the Service Module. The total heat load may reach 20 watts including a continuous internal load of 12 watts. An evaporative cooling system has been developed for use during the time that the water temperature exceeds a thermostat setting of 65 F. Passive thermal control is employed during conditions of low ambient temperatures as well as during the prelaunch phase, when the evaporative cooler is inoperative. The program has reached the completion of the Engineering Model phase. This report includes a summary of the thermal vacuum test program which was carried out to verify the adequacy of the temperature control system. The results have been implemented in the design of the flight prototype and flight models to be supplied to NASA in 1966. Author (TAB)

N67-25018*# National Aeronautics and Space Administration, Washington, D. C.
RESEARCH ON THE INITIAL FACTORS OF MORPHOGENESIS IN ANURAN AMPHIBIA. PART I: RESULTS OF THE SCHULTZE EXPERIMENT AND THEIR INTERPRETATION [RECHERCHES SUR LES FACTEURS INITIAUX DE LA MORPHOGENESE CHEZ LES AMPHIBIENS ANOURES. I. RESULTATS DE L'EXPERIENCE DE SCHULTZE ET LEUR INTERPRETATION]

J. Pasteels Mar. 1967 27 p refs Transl. into ENGLISH from Arch. de Biol. (Liege), v. 49, 1938 p 629–667
(NASA-TT-F-10793) CFSTI: HC $3.00/MF $0.65 CSCL 06C

With respect to the initiating factors of morphogenesis in tailless amphibians, the results of the Schultze experiments (compression and inversion of the ovum after or at the beginning of segmentation) are interpreted and modified, using the fertilized undivided ova of Rana fusca, Rana esculenta, and Discoglossus pictus as experimental material. It is demonstrated that all points on the surface of the ovum are able to form a dorsal blastopore lip, provided that certain conditions for appearance of the prodromes of morphogenesis are met, including contact between the white vitelline substance of the vegetative pole and the pigmented substance. The prodromes of morphogenesis are due to an interaction of chemical nature between the vitelline gradient and a cortical substance distributed over a cortical dorsoventral field whose intensity decreases progressively from a dorsal focus. The dorsal lip of the blastopore forms the true nodal point of a complex system and has a dominant physiological action on the less developed lateroventral regions. The vitelline gradient determines the cephalocaudal polarity. Author

N67-25020*# National Aeronautics and Space Administration, Washington, D. C.
RESEARCH ON THE MORPHOGENESIS AND DETERMINISM OF UNEQUAL SEGMENTATIONS IN SPIRALIA [RECHERCHES SUR LA MORPHOGENESE ET LE DETERMINISME DES SEGMENTATIONS INEGALES CHEZ LES SPIRALIA]
J. Pasteels Mar. 1967 28 p refs Transl. into ENGLISH from Arch. Anat. Microscop. (France), v. 30, 1934 p 161–197
(NASA-TT-F-10817) CFSTI: HC $3.00/MF $0.65 CSCL 06C

The morphogenesis and determinism of unequal segmentations in Spiralia (Aplysia, Myzostoma, and Chaetopterus) is described in detail, with discussion of various theories by different authors. Equalization of unequal segmentation, produced by ultraviolet irradiation, centrifugation, freezing, and narcotization, applied at the moment of division, during maturation, or even to the virgin ovum, resulted in the development of duplicitas. The mechanism of unequal segmentations was found to be unrelated with either unequal division of the centrosome, asymmetric special structures of the achromatic spindle, or intervention of dyschronism. The hypothesis for this mechanism postulates a differing distribution and condensation of substances, analogous to that of the polar cytoplasm and offering a certain resistance to cytodieretic processes. These substances would be germinal localizations, thus explaining the link between unequal segmentation and morphogenesis. Author

N67-25047* Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.
STORAGE OF BIOLOGICAL SAMPLES
T. M. Fraser Washington, NASA, May 1967 31 p refs
(Contract NASr-115)
(NASA-CR-781) CFSTI: $3.00 CSCL 06C

The possibilities of prolonged storage of biological samples taken during orbital flight are examined. It is assumed that the Apollo-type spacecraft will have one crew member trained in the necessary sampling and storage techniques, and that the mission will be of 15, 30, 45, or 90 days duration. Test materials and sources are listed, showing the parameters for serum or plasma, urine, whole blood, feces, and sweat. Such storage techniques as unprocessed, chemical preservation, refrigeration, freezing, lyophilization or vacuum freeze drying, and drying are discussed. Tabulated data are presented to indicate the acceptable duration of storage under different circumstances for standard clinical laboratory techniques, and the minimum storage requirement for different flight durations. It is pointed out that even for the 15-day mission all forms of storage will be required. M.G.J.

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N67-23603# Army Medical Research Lab., Fort Knox, Ky. Experimental Psychology Div.
CHARACTERISTIC PACE AS DETERMINED BY THE USE OF A TRACKING TREADMILL
Gary L. Holmgren and George S. Harker 14 Nov. 1966 21 p refs
(Rept.-685; AD-645454) CFSTI: HC $3.00/MF $0.65

It was found that when subjects walked on a tracking treadmill under a comfortable-but-determined (C-D) walking instructional set for a minimum of 30 min on each of three testing days: (1) subjects demonstrated a characteristic C-D pace that was stable on any given day; (2) subjects' C-D pace differed statistically from each other ($P < 0.001$); and (3) subjects' C-D pace measures were most reliable between testing days 2 and 3 ($P < 0.01$). Author (TAB)

N67-23606# National Cash Register Co., Dayton, Ohio.
EFFORT TO EVOLVE A METHOD OF EYE PROTECTION FROM FLASH BLINDNESS Final Report, 1 Oct. 1965–31 Aug. 1966
Robert C. Bertelson, Kenneth D. Glanz, David B. McQuain, and Francis D. Thomson Brooks AFB, Tex., School of Aerospace Med., Dec. 1966 57 p refs
(Contract AF 41(609)-2957)
(AD-645730) CFSTI: HC $3.00/MF $0.65

Photochromics of the spirobi(naphthopyran) classes are shown to give significant improvements over present spiropyrans when used in practical eye-protection systems. In particular, the open-state luminous transmittance of the total system was increased to 67% while still retaining the capability of closing to a luminous density of approximately 3 within 100 micro sec. The photobleaching by visible light was negligible even at intensities corresponding to a nuclear weapon range at which the aircraft and crew could not survive. The preparation of a variety of new photochromics and the necessary intermediates is described. Author (TAB)

N67-23680# Naval Research Lab., Washington, D. C.
PILOT COMPARISON OF TWO THERMOLUMINESCENT DOSIMETRY SYSTEMS WITH FILM BADGES IN ROUTING PERSONNEL MONITORING
T. L. Johnson and F. H. Attix 3 Jan. 1967 36 p refs *Its* Test and Evaluation Report 69
(AD-645901) CFSTI: HC $3.00/MF $0.65

An intercomparison was made of the performance of two thermoluminescent dosimetry (TLD) systems and conventional film badges in a routine gamma-ray personnel monitoring operation. Quartz fiber pocket dosimeters were worn in some cases also, but were read out more frequently than the monthly interval used for the other systems. One of the TLD systems consisted of the U.S. Navy experimental prototype Computer-Indicator CP-748(XN-1)/PD and Detectors DT-284(XN-1)/PD, (respectively the reader and dosimeters). The other was a commercial model of foreign manufacture which will be referred to here as the M system. Both of these types of dosimeters employed calcium fluoride TLD material sealed in a glass envelope with an internal ohmic heater. Both types of TLDs were found to contain radioactive contamination which gave rise to background readings in excess of ambient background by approximately 21-24 mR/mo. Author (TAB)

N67-23821# School of Aerospace Medicine, Brooks AFB, Tex.
AN EXPLORATORY STUDY OF FACTORS AFFECTING AIRCREW MORALE
Bryce O. Hartman, George K. Cantrell, and Lewis S. Sims Jul. 1966 13 p refs
(SAM-TR-66-62; AD-639141) CFSTI: HC $3.00/MF $0.65

Aircrew morale was studied in 176 MAC aircrewmen. In interviews and questionnaires, nine problem areas were identified. The primary problem reported by the aircrewmen was lack of planned free time. This factor had a negative effect both on duty and off duty. The remaining eight factors were more specific to the working environment. Several were a function of the mission of the command but some were accessible to local modification. In the face of these problems, aircrewmen maintained good motivation, probably because of the satisfactions obtained from flying and from other aspects of their Air Force careers. Author (TAB)

N67-23853# University of Southern Calif., Los Angeles.
BIOLOGICAL ENGINEERING
W. Morrison and G. A. Bekey In its [Solid State, Appl. Electromagnetics and Plasmas, and Inform. Sci.] 30 Sep. 1966 p 178–183 (See N67-23841 12-26)
(Grant NIH NB-06196-01)

A digital sequence generator was designed and fabricated for the direct electrical stimulation of walking movements in paraplegic animals. Patterned movements of dog knee and hip flexors were obtained by imbedded needle electrodes. Mathematical models of the spinal control reflex were validated by comparing computer simulations with the performance of human subjects in a manual tracking task. G.G.

N67-23868# Bunker-Ramo Corp., Canoga Park, Calif.
HUMAN ENGINEERING SUPPORT TO AIR FORCE FLIGHT CONTROL AND FLIGHT DISPLAY INTEGRATION PROGRAM Final Report, 15 Mar. 1965–11 Mar. 1966
Gerald F. Rabideau and Clarence A. Semple, Jr. Mar. 1966 17 p refs
(Contract AF 33(657)-8600)
(AD-646016) CFSTI: HC $3.00/MF $0.65

The Bunker-Ramo program of human engineering tasks may be characterized as broad in scope and covering a diverse collection of control-display problems. Technical activities included consultation, participation as members of control-display system teams, reviews and analyses of specific control-display problem literature, development and study of methodological problems, experimentation and development of human engineering methods, and evaluation of controls and displays. The objectives of the individual tasks and their nature are briefly reviewed and discussed in this report. References are made to Technical Reports pertinent to the completion of each of the tasks. Individual reports, however, are not included as a part of this Summary Final Report. Among the most significant human engineering contributions were those concerned with the development of solid state (electroluminescent) display concepts, V/STOL and Multi-Jet Transport control-display configurational work, the determination of scale factors critical to tape information display, evaluation of the photochromic display, simulator evaluation of a side stick controller, inflight evaluation of force wheel steering in the heavy transport aircraft, a preliminary evaluation of a microvision display and an assessment of the state-of-the-art with respect to attitude indicators. TAB

N67-23923# Johns Hopkins Univ., Baltimore, Md.
MOUNTING ANGLE OF A VJ REMOTE RADAR INDICATOR AND ITS EFFECT ON OPERATOR PERFORMANCE
A. Chapanis [1947] 13 p refs
(TR-166-1-41; AD-646273) CFSTI: HC $3.00/MF $0.65

A VJ remote radar indicator was mounted at seven angles (scope-face with respect to the floor: 0, 15, 30, 45, 60, 75, 90 degrees) and tests were made to discover whether there is an optimum mounting angle for operator performance. The results of the experiment show that the angle at which a VJ is mounted has no significant effect on an operators speed and/or accuracy in target indication. A questionnaire was given to the group of subject-operators used in the experiment to determine which mounting angle they preferred. An analysis of these results gave the following rank order (from most to least preferred): 15, 45, 30, 60, 0, 75, 90 degrees. The 0 degrees position is the conventional mounting angle. Author (TAB)

N67-23932# Systems Technology, Inc., Hawthorne, Calif.
HUMAN PILOT DYNAMIC RESPONSE IN SINGLE-LOOP SYSTEMS WITH COMPENSATORY AND PURSUIT DISPLAYS
R. J. Wasicko, D. T. McRuer, and R. E. Magdaleno Dec. 1966 79 p refs
(Contract AF 33(657)-10835)
(STI-TR-134-4; AFFDL-TR-66-137; AD-646652) CFSTI: HC $3.00/MF $0.65

The primary purpose of the experimental series reported here is to investigate, on a preliminary and exploratory basis, human operator performance differences between pursuit and compensatory displays. For each display type a wide range of forcing function bandwidths and controlled element dynamics was used. The effect of the additional information provided by separately displaying both forcing function and controlled element output (pursuit) rather than their difference (compensatory) was evaluated using the mean-squared error and a quantity called the effective open-loop describing function (Y beta). As a prelude to the new data, past pursuit/compensatory tracking results are reviewed, and then a tie-in is made between these and the current series. Author (TAB)

N67-23938# Systems Technology, Inc., Hawthorne, Calif.
EFFECTS OF MANIPULATOR RESTRAINTS ON HUMAN OPERATOR PERFORMANCE
R. E. Magdaleno and D. T. McRuer Dec. 1966 55 p refs
(Contract AF 33(657)-10835)
(STI-TR-134-2; AFFDL-TR-66-72; AD-645289) CFSTI: HC $3.00/MF $0.65

The purpose of the experimental efforts is to explore on a preliminary basis the limiting characteristics of the human operators actuator or neuromuscular system dynamics as effected by the manipulator. The effects of three manipulators (pressure, free-moving, and spring-restrained) on system performance and the human operators describing function are presented for three controlled elements and two high bandwidth forcing functions. Describing function differences are primarily in the phase, i.e., the effective time delay at high-frequency and an effective phase lag at very low frequencies. Generally the mean square error and describing function results for the spring-restrained manipulator were intermediate to those for the free-moving (no spring) and the pressure (infinite spring) manipulators. The pressure controller gave lower mean square error and less effective time delay than the free-moving controller. In addition, the effective phase lag at very low frequencies was either the same as or larger than that for the free-moving control. Author (TAB)

N67-24279# Boeing Co., Seattle, Wash.
DEVELOPMENT OF A DEVICE FOR PHYSICAL CONDITIONING DURING WEIGHTLESSNESS
Gary Chase, Caswell Grave, John Goode, and Gary Graham *In* NASA Marshall Space Flight Center Proc. of the Interdisciplinary Symp. on Apollo Appl. Programs, 12–13 Jan. 1966 Dec. 1966 p 241–248 refs (See N67-24268 12-30)

Reported are laboratory and engineering design studies of an exercise device for maintaining the functional integrity and physical well being of astronauts during exposure to a weightless

environment. The device, which resembles a double trampoline, was designed for testing in an experimental simulation (bed rest) of the zero-g environment. It provides conditioning for the muscular, skeletal, and cardiovascular system by imparting cyclic, pulsatile accelerations along the long axis of the body. A runner-mounted carrier supports the subject in a face-up, horizontal position and is free to move back and forth between two vertical, opposed trampolines. The subject oscillates by bouncing between the trampolines over a distance necessary to develop the desired acceleration-time profile. Preliminary implications of laboratory studies, and details of machine construction are included. Also included is a concept for a lightweight model for eventual application in a space station. It is suggested that the trampoline device be tested and analyzed along with other methods for preventing deconditioning of the astronaut. S.C.W.

N67-24375# Naval Missile Center, Point Mugu, Calif.
TIMED HEAT-RELEASE CHEMICAL SYSTEM FOR UNDERWATER APPLICATIONS
K. N. Tinklepaugh and C. J. Crowell, Jr. 20 Feb. 1967 26 p refs
(TM-67-1; AD-647892) CFSTI: HC $3.00/MF $0.65

Divers and aviators downed in the ocean require warming to prevent excessive loss of body heat. A combination of chemical heating and fabric insulation was evaluated for this purpose. Chemical heating results from the programmed heat of solution of an inexpensive cream in water. Less than 25 pounds per hour for the aviator and 5 pounds per hour for the wet-suit diver will probably be required to prevent excessive loss of body heat. Author (TAB)

N67-24403# Aerojet General Corp., Azusa, Calif.
ANALYSIS OF TRACE CONTAMINANTS IN CLOSED ECOLOGIC ATMOSPHERES
M. L. Moberg Dec. 1966 25 p
(Contract AF 41(609)-2783)
(SAM-TR-66-99; AD-647618) CFSTI: HC $3.00/MF $0.65

A 27-day experiment designed to determine mans contribution to trace contaminants in a sealed environment was conducted jointly by the United States Air Force and the National Aeronautics and Space Administration. Direct analysis of the sealed environment was not adequate for this type of comprehensive survey. The use of cryogenic fractionation and concentration, however, did provide samples with sufficient level of contaminants for analysis by means of gas chromatography and mass spectroscopy. Author (TAB)

N67-24429# Arbeitsgruppe Biophysikalische Raumforschung, Frankfurt am Main (West Germany).
AN AUTOMATIC BIO-SONDE FOR SERVICE IN SATELLITES [EINE AUTOMATISCHE "BIOSONDE" FUER DEN EINSATZ IN SATELLITEN]
Robert G. A. Lotz *In its* Extraterrest. Biophys. and Biol. [1966] p 37–41 (See N67-24424 12-04)

Described is the development and construction of a biosonde that is able to support small animals in an orbiting satellite for over one year. This ecological loop system contains in succession an animal chamber, an impurity filter, an adsorption filter or ion exchanger, a carbon dioxide absorption filter, and an electrolytic cell. The m/15 phosphate buffer solution of the system is circulated by centrifugal pump; the entire physiological support system is hermetically sealed but contains a circular window encased in an elastic membrane. Changes in membrane pressure caused by oxygen absorption of the enclosed animal are monitored by a photoelectric pressure transducer which in turn agitates the electrolytic cell to reconstitute the necessary oxygen amount. This life support system weighs under 3 kg and requires only 2.5 to 3 Watt power; it can be used in connection with telemetry to monitor the biological rhythms in full. Transl. by G.G.

N67-24436# Gottingen Univ. (West Germany). Institut fuer Mikrobiologie.
CLOSED ECOLOGICAL SYSTEMS—REGENERATION OF AIR FOR BREATHING [GESCHLOSSENE OEKOLOGISCHE SYSTEME—ATEMLUFTREGENERATION]
H. G. Schlegel *In* Arbeitsgruppe Biophys. Raumforsch. Extraterrest. Biophys. and Biol. [1966] p 87–93 (See N67-24424 12-04)

Removal of carbon dioxide, oxygen regeneration, and the production of nutritional substances by microorganism are considered for closed ecological systems during prolonged space flight. Oxygen regeneration by chemical reduction of carbon dioxide and electrolytic decomposition of the obtained water requires relative high reaction temperatures and produces additional carbon monoxide and methane; oxygen regeneration by bioregenerative photosynthetic processes, using algae, utilizes only 2 to 5% of the energy source and poses a problematic weight factor; oxygen regeneration by biogenerative chemosynthetic systems of microorganism produces molecular hydrogen and oxygen from water electrolysis. Experiments with Hydrogenomonas bacteria show an energy consumption of 0.6 kW for the hydrolysis of 200 mol H_2O. Transl. by G.G.

N67-24479*# Little (Arthur D.), Inc., Cambridge, Mass.
A PROGRAM OF RESEARCH DIRECTED TOWARD THE EFFICIENT AND ACCURATE MACHINE RECOGNITION OF HUMAN SPEECH Final Report
Huseyin Yilmaz 14 Dec. 1966 69 p refs
(Contract NAS12-129)
(NASA-CR-80020; C-68366) CFSTI: HC $3.00/MF $0.65 CSCL 06H

A theory of speech perception is presented which falls within a more general approach to the problem of perception. This approach is evolutionary in its philosophy and statistical in its methods. It considers the physical properties of the stimulus energy and its statistical distributions in the environment, and the needs of the organism in terms of individual and social survival. Given suitable neural material and biochemical processes, and enough time for evolutionary forces to assert themselves, the perceptual devices evolve toward a functional optimum. A theory of vowel perception is given which is sufficiently specific to provide the parameters and their numerical values for constructing a device to test the validity and to demonstrate the practical usefulness of the approach. The construction and performance of the device are described along with suggestions for its improvement. Experiments performed on the device are presented. They were suggested by the evolutionary theory and their outcomes agree with those predicted by the theory. Other existing approaches are discussed and compared with the evolutionary approach to perception theory. R.N.A.

N67-24572# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
ROCKY FLATS RESPIRATOR-FITTING PROGRAM
S. E. Hammond and J. E. Hill 28 Nov. 1966 5 p refs
(Contract AT(29-1)-1106)
(RFP-810) CFSTI: HC $3.00/MF $0.65

The experience is reviewed of fitting, in the field, over 2000 workers with several different types of half-mask respirators used for protection from toxic materials. Procedures, numbers receiving a satisfactory fit, and areas of possible respirator improvement are discussed. Author (NSA)

N67-24687 Royal Aircraft Establishment, Farnborough (England).
AIRCREW PROTECTION IN HIGH TEMPERATURE SURROUNDINGS [PROTECTION DE L'AVIATEUR CONTRE LES AMBIANCES THERMIQUES ELEVEES]
J. Colin and V. Houdas Dec. 1966 30 p refs Transl. into ENGLISH from Rev. Corps Santa, v. 6, n. 5, 1965 p 589–611
(RAE-LIB-TRANS-1205)

The four basic mechanisms in heat transfer between man and his environment, namely convection, radiation, evaporation, and conduction are analyzed. The use of ventilated suits to provide protection against extreme ambient temperatures is discussed and two designs described. A technique for measuring the effectiveness of air ventilated suits is propounded, involving calculation of the total heat lost or gained by the subject from a knowledge of body weight, average specific heat and average temperature, the last being derived from measurement of surface and deep body temperatures. Experimental results are given for a particular suit, and a nomogram provided to enable suit air flows to be calculated for various ambient temperatures. Author

N67-24597# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
THE TRAINING OF SUBJECTS FOR UTIAS RESEARCH ON DYNAMICS OF HUMAN PILOTS
Rae R. Simpson Mar. 1967 55 p refs
(UTIAS-TN-106) CFSTI: HC $3.00/MF $0.65

The facility and the techniques used for the initial training of subjects for current research on human pilot dynamics are described. The data on the progress of training are presented and analyzed for each subject, and criteria are introduced for evaluation of the degree of proficiency of the subject. Initial steps to refine the system for future work are also described. Author

N67-24655# RAND Corp., Santa Monica, Calif.
RATED ASSOCIATION VALUES OF 251 COLORS
Samuel W. Cochran Jan. 1967 14 p refs
(P-3511; AD-647433) CFSTI: HC $3.00/MF $0.65

Color has been used as a variable in learning experiments (e.g., Weiss and Margolius, 1954, and Hill and Wickens, 1962); however, a direct calibration of the association value of colors has not been made. In an effort to supply this information, this paper reports the rated association values of 251 centroid colors. The study indicates that colors do differ in association value; therefore, it is suggested that the association value of colors should be considered when color is a variable in learning experiments. Author (TAB)

N67-24702# Naval Air Engineering Center, Philadelphia, Pa.
AN ENVIRONMENTAL WHOLE-BODY PLETHYSMOGRAPH
E. Hendler, D. W. Dery, J. B. Kearney, and S. Greco 13 Jan. 1967 5 p
(NAEC-ACEL-545; AD-646721) CFSTI: HC $3.00/MF $0.65

A device is described which functions both as a whole-body plethysmograph and as an environmental chamber, in which human subjects can be confined for prolonged periods. This device has been used to make pulmonary function measures while subjects have been exposed over 12 hour periods to air and 100 per cent oxygen, both at sea level and at altitude. Author (TAB)

N67-24712# Eye Research Foundation of Bethesda, Md.
THE EFFECT OF WAVELENGTH ON VISUAL ACUITY
Final Report, Oct. 1, 1965–Sep. 31, 1966
Carl Richard Cavonius Jan. 1967 22 p refs
(Contract DA-49-193-MD-2839)
(ERF-RR-1/67-Cr; AD-646575) CFSTI: HC $3.00/MF $0.65

Visual acuity was measured in monochromatic light at wavelengths between 440 and 660 nm. The test objects were gratings which filled a 1.5 degree circular field centered in a 30 degree neutral surround. Luminance contrast between adjacent bars was adjustable, and acuity thresholds were determined for different contrasts. It was found that acuity depends primarily on luminance contrast and only slightly on wavelength, so that the same luminance contrast yields similar acuity thresholds at all wavelengths provided that the test objects are equated in luminance. It is suggested that the dominant wavelength of a visual display system (such as a cathode ray screen) is relatively unimportant in the perception of fine detail. Instead, criteria such as grain size and available luminance are more important. Author (TAB)

N67-24714# American Inst. for Research, Washington, D. C.
GOALS AND INTENTIONS AS DETERMINANTS OF PERFORMANCE LEVEL, TASK CHOICE AND ATTITUDES
Final Report, Feb. 1, 1965–Jan. 31, 1967
Edwin A. Locke and Judith F. Bryan Jan. 1967 100 p refs
(Contract Nonr-4792(00))
(AIR-E-51-1/67-FR; AD-646392) CFSTI: HC $3.00/MF $0.65

Twenty laboratory experiments and 2 field studies were carried out to explore the relationship of goals and intentions to level of performance on tasks, task choice, and liking for, and interest in the task. The results indicated that: (1) hard goals led to a higher level of performance than easy goals and to a higher performance level than a goal of, do your best.; (2) incentives such as knowledge of score, money, and time limits did not affect performance level independently of S's goals; (3) there was a significant relationship between behavioral intentions and choice behavior and there was no effect of monetary incentives on choice independently of S's behavioral intentions; (4) overall task liking and satisfaction with performance were positive, linear functions of the number of successes achieved on the task; further, the amount of satisfaction attained from a given success was greater when: S had expended the most effort to achieve it; when S succeeded in less time than usual; and when success followed other successes rather than a series of failures; (5) specific hard goals produced more task interest than a goal of, do your best, (this difference was enhanced if the experiment lasted more than 2 hours); (6) there was no relationship between task liking or interest and performance or performance improvement; both liking and performance were determined by the nature and difficulty of the individuals goal, rather than by each other. Author (TAB)

N67-24724# Antioch Coll., Yellow Springs, Ohio. Behavior Research Lab.
HUMAN FACTORS IN THE DESIGN OF ELECTROLUMINESCENT DISPLAYS FOR AEROSPACE EQUIPMENT Final Report, 1 May 1965–1 May 1966
Herbert H. Stenson Wright-Patterson AFB, Ohio. Aerospace Med. Res. Labs., Sep. 1966 38 p refs
(Contract AF 33(615)-1088)
(AMRL-TR-66-130; AD-646459) CFSTI: HC $3.00/MF $0.65

The report presents an outline of a broad program of psychological research that will provide human engineering standards for the design of electroluminescent (EL) display devices. The physical characteristics of EL lighting are discussed, after which the possible types of EL displays are categorized as discrete or continuous displays, and as dynamic or static displays. Five types of perceptual tasks that might be required of an observer of an EL display are described, and each display category is then discussed in terms of the perceptual task(s) required to monitor the display in question. For each display-task combination, human factor research is proposed and some experiments are laid out in detail. The conventional variables such as intensity, contrast and viewing duration are considered for each display-task category as well as some less familiar variables based on the use of information theory. Examples of existing and proposed EL displays are given in connection with the proposed research. TAB

N67-24728# Massachusetts Univ., Amherst.
FACTORS AFFECTING INFORMATION PROCESSING IN SHORT-TERM MEMORY
Stanley M. Moss, Joseph F. Hearns, and John B. Soward Dec. 1966 75 p refs
(Contract Nonr-3357(06))
(Rept.-2; AD-646373) CFSTI: HC $3.00/MF $0.65

Three experiments were conducted to investigate several of the variables that affect information processing in short-term memory as reflected by the strategies used by Ss in a visual search task. The first study investigated differences in strategy as a function of method of payoff. The second study was concerned with changes in strategy when Ss shifted from one incentive ratio to another. The third study was concerned with differences in strategy when Ss were confronted with different work loads. Two general conclusions have emerged from these investigations. First, Ss strategy for optimal information processing in this task is determined by his method of payoff and his work load (Study 1 and Study 2). Second, the degree to which a strategy can be successfully implemented is limited by the interference effects of differential target value and value ratio (Study 1 and Study 2).
Author (TAB)

N67-24740# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
APERTURE SIZES AND DEPTHS OF REACH FOR ONE- AND TWO-HANDED TASKS Final Report, Jun. 1962–Nov. 1965
Kenneth W. Kennedy and Byron E. Filler Oct. 1966 42 p refs
(AMRL-TR-66-27; AD-646716) CFSTI: HC $3.00/MF $0.65

The report presents data on (1) the optimal sizes and locations of maintenance apertures, and (2) mans working-reach distances through such apertures, for both the shirt-sleeved and the pressure-suited conditions. In all cases, the vertical dimension of the aperture permits the technician to maintain simultaneous visual and manual contact with the task area. Data include Depth of Reach, Breadth of Aperture, Vertical Dimension of Aperture, and distances to the floor from both the lower and the upper edges of these apertures. Different apertures provide for forward or lateral reaches, in the standing or seated position, with one or both arms. Data are reported in the 5th, 25th, 50th, 75th and 95th percentiles. Ranges, Means and Standard Deviations are given. Recommendations are made regarding the appropriate application of maintenance accesses.
Author (TAB)

N67-24757# Stanford Univ., Calif. Graduate School of Business.
PERCEPTION OF LEADERSHIP IN SMALL GROUPS Final Report
Thomas W. Harrell Jan. 1967 18 p refs
(Contract Nonr-225(62))
(AD-646769) CFSTI: HC $3.00/MF $0.65

Three hundred thirty-four men were studied in four and five man discussion groups. Some groups met for four sessions. An outside observer counted the number of times each man talked. Discussion group members rated the others and themselves on Participation, Best Ideas, Guidance, and Leadership. Discussion group members rated the others only on Being Liked. Subjects took a nine instrument personality test battery. At the end of the course subjects plus other class members rated each other on their positive and negative choices for Boss, Emotional Maturity, and Friend and Associate. There were no clear cut role differentiation at the end of four sessions. Peer ratings for positive and negative boss correlated significantly with current grade point average but not very much with test scores. There were some significant differences between the extreme performers in the small discussion groups on their peer ratings. There were a few significant personality test differences between the extreme performers in the small discussion groups.
Author (TAB)

N67-24778# RCA Service Co., Inc., Camden, N. J.
DEVELOPMENT AND EXPERIMENTAL EVALUATION OF AN AUTOMATED MULTI-MEDIA COURSE ON TRANSISTORS Final Report, Apr. 1965–Jun. 1966
J. H. Whitted, Jr., Edward E. Weaver, and John P. Foley, Jr.
Wright-Patterson AFB, Ohio, AMRL, Sep. 1966 114 p refs
(Contract AF 33(615)-2880)
(AMRL-TR-66-142; AD-646671) CFSTI: HC $3.00/MF $0.65

A completely automated multi-media self-study program for teaching a portion of electronic solid-state fundamentals was developed. The subject matter areas included were fundamental theory of transistors, transistor amplifier fundamentals, and simple mathematical analysis of transistors including equivalent circuits, parameters, and characteristic curves. The media included a tape slide audio-visual presentations, a programmed text, a cued text, a sound movie, a workbook, and a RCA transistor trainer. A controlled experiment was conducted, comparing the effectiveness of the self-sufficient multi-media materials, with a conventional instructor/classroom presentation and existing self-study materials from Air Force Extension Course Institute. Even though the instructor/classroom subjects received somewhat higher ratio gain scores, on the average, than the multi-media subjects, this difference was not significant. Both of these modes were superior in effectiveness to the extension course materials. The principal measures of this effectiveness were a pre-test and a post-test made up of multiple choice items concerning the solid state theory covered.
Author (TAB)

N67-24802# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE TESTERS
D. Pipko 12 Dec. 1966 30 p Transl. into ENGLISH from Nauka i Zhizn (Moscow), no. 4, 1966 p 42–52
(FTD-HT-66-352; TT-67-61120; AD-647712) CFSTI: HC $3.00/MF $0.65

The article gives a brief description of the history of aviation and ground experiments which led up to the first space flight by Yury Gagarin. Many medical and psychological experiments are narrated, such as normality, euphoria, and hypodynamia in space flight and the correction thereof. Equipment tests are reviewed.
Author (TAB)

N67-24825# Human Engineering Labs., Aberdeen Proving Ground, Md.
AN ANALYTICAL METHODOLOGY FOR ESTIMATING CREW COMPOSITION OF A TWO-MAN ARMY AERIAL VEHICLE
Michael A. Famiglietti, Stephan Moreland, and Joseph H. Sullivan Jun. 1966 19 p
(TM-7-66; AD-646800) CFSTI: HC $3.00/MF $0.65

This report describes a method for making coarse quantitative estimates of crew composition for a two-man Army aerial vehicle. It assumes that crew composition depends predominantly on the tasks men are assigned to perform. For illustration the method is applied to an aerial-vehicle concept for high-speed, low-altitude surveillance and target acquisition.
TAB

N67-24834# Federal Aviation Agency, Oklahoma City, Okla. Office of Aviation Medicine.
PHYSIOLOGICAL RESPONSES OF PILOTS TO SEVERE WEATHER FLYING
Jess M. McKensie and Vincent Fiorica Jul. 1966 15 p refs
(AM-66-41; AD-646871) CFSTI: HC $3.00/MF $0.65

Selected measurements of stress-related and other physiological variables were made on jet aircraft pilots participating in USWB-NSSL turbulent weather programs. Data were gathered from two categories of flying conditions: (1) storm penetration flights (Scimitar type aircraft) and (2) storm perimeter flights (Canberra type aircraft). Measurements made before and after each flight included urinary catecholamine levels, urinary electrolyte concentrations, urinary hemoglobin levels and body weight. Results indicate a direct relationship between catecholamine output during the penetration flights and the pilots evaluation of the turbulence

encountered. Increased output of catecholamines also corresponded to unusual inflight experiences during storm penetrations. No relationship between catecholamine output and instrumentally measured turbulence was detected in the Canberra aircraft. The data indicate that turbulence effects on sympathoadrenal responses are related to the pilots evaluation of the turbulence. Stress responses to severe weather flying may be related to the pilots previous experience and other factors which affect his assessment of the storm. Author (TAB)

N67-24837# George Washington, Univ., Washington, D. C. Human Resources Research Office.

PURSUIT ROTOR PERFORMANCE: II. EFFECTS OF REINFORCING SUCCESSIVELY LONGER INTERVALS OF CONTINUOUS TRACKING OVER PRACTICE SESSIONS

Richard W. Sheldon and John F. Bjorklund Dec. 1966 16 p refs

(Contract DA-44-188-ARO-2)

(TR-66-22; AD-646799) CFSTI: HC $3.00/MF $0.65

The objective was to determine whether pursuit rotor performance would be facilitated, and the level of achievement sustained, with the use of the reinforcement technique of shaping. The procedure used in this study was progressively lengthening, from session to session, the continuous target contact required to obtain a reinforcement, keeping the duration requirement constant within each session. Two groups of four subjects each practiced under the experimental conditions for ten 15-trial sessions. Reinforcement was provided during Sessions 2-7. Half of the experimental subjects improved appreciably during the reinforced practice. When reinforcement was withdrawn, the differences between the mean performance levels of the experimental subjects and a control group of eight subjects, who practiced without any reinforcement, were negligible. TAB

N67-24841# Federation of American Societies for Experimental Biology, Washington, D. C. Life Sciences Research Office.

A STUDY OF MILITARY IMPLICATIONS OF PROTECTIVE DEVICES DESIGNED TO PREVENT OR AMELIORATE HEAD AND NECK INJURIES

Sep. 1966 67 p

(Contract DA-49-092-ARO-70)

(AD-646841) CFSTI: HC $3.00/MF $0.65

The major crash survival variables affecting the design and testing of U.S. Army aircrewmen helmets are presented and discussed. Such factors as head acceleration limits, impact velocity, impact surfaces, impact sites, suspension and retention harnesses, helmet ventilation, impact test methods, and structural concepts are considered. An examination of all available data on the tolerance of the human head to deceleration was conducted. Consideration was given to an analysis of acceptable design limits. A parallel study of head injuries occurring in aircraft accidents was conducted to determine the significant injury areas of the head and correlate this to protection area and techniques. A cockpit survey was conducted to develop criteria for testing the helmet and liner materials. Consideration was given during the program to a preliminary investigation of helmet retention systems and head cooling techniques. A series of instrumented drop tests was conducted to investigate various helmet design concepts and materials. Double-shell and single-shell helmets of nearly equal weight were analyzed. The advantages and disadvantages of three different methods of helmet impact testing are discussed. Author (TAB)

N67-24851# Washington Univ., Seattle. Dept. of Atmospheric Sciences.

WATER TRANSFER THROUGH HUMAN SKIN Final Technical Report

Konrad J. K. Buettner, Evelyne Robbins, Jean Crichlow, Margarete Pitts, David Jones et al [1966] 7 p refs

(Contract Nonr-477(22))

(AD-646848) CFSTI: HC $3.00/MF $0.65

The main purpose of this study was the investigation of the transfer function of human skin. G. E. Folk, R. E. Peary and K. Buettner discovered independently the passage of water from weak salt solutions into the human foot. This statement proved true also for hands, arms, backs, soles of man and for the non-hairy part of rabbits ears. The transfer into the body can also be observed if air of more than 90% relative humidity, and of skin temperature covers the skin. Author (TAB)

N67-24869# American Inst. of Biological Sciences, Washington, D. C.

INSTRUMENT CONCEPTS: DEVELOPING A MULTI-PARAMETER VASCULAR ACTIVITY METER

Carl A. Budde (Diginetics, Glendale, Calif.) 1 Aug. 1966 5 p refs

(Contracts NASr-132; Nonr-4526(04))

(AD-647290) CFSTI: HC $3.00/MF $0.65

A new multivariable measuring instrument is described which could make a substantial contribution to a practical tool in cardiovascular measurements. The Biomedical Electronics Division of Diginetics is approaching the stroke problem from a logical standpoint, that is: utilizing the eye as the physiological and anatomical window into the brain of which it is an extension. By monitoring or examining the blood vessels of the eye, especially the retina, one can gain information regarding the blood vessels and hemodynamic or circulatory parameters necessary in order to diagnose and treat insufficiency or obstruction of the cerebral blood supply. Author (TAB)

N67-24879# Army Medical Research Lab., Fort Knox, Ky.

CORRELATION OF PERFORMANCE IN DETECTING VISUAL AND AUDITORY SIGNALS Final Report

Walter J. Gunn and Michel Loeb 20 Jan. 1967 16 p refs

(AMRL-713; AD-647539) CFSTI: HC $3.00/MF $0.65

Two experiments were performed in which Os were to detect which pulses of noise or pulses of light were slightly more intense than others in a train. It was found in the first experiment that both sensitivity (d) and degree of conservatism in responding (beta) were correlated for the two tasks. The auditory task was more difficult than the visual under the chosen conditions. Higher betas were noted for Os first performing on the visual task. In the second experiment, the tasks were more closely equated in difficulty, and Os performed both the auditory and the visual task twice. The effect of order previously noted for beta was not obtained. Beta and d were again significantly correlated for the first session; for the second session significant correlations were obtained for d but not beta. The results suggest that not only are there response biases common to detection in different modalities but also common factors affecting sensitivity. Author (TAB)

N67-24906# MSA Research Corp., Evans City, Pa.

SUPEROXIDE CONFIGURATIONS FOR ATMOSPHERE CONTROL SYSTEMS Final Report, Apr. 1965-Jun. 1966

M. J. McGoff Wright-Patterson AFB, Ohio, AMRL, Nov. 1966 78 p ref

(Contract AF 33(615)-2792)

(MSAR-66-144; AMRL-TR-66-167; AD-647135) CFSTI: HC $3.00/MF $0.65

Solid superoxide forms were studied to evolve optimized configuration designs for life support of one man on 2-, 4-, 8-, 24-, and 48-hour space missions. Suitable designs were developed to generate O2 for these missions, but CO2 control becomes progressively more difficult as mission time decreases. Optimization for short mission configurations were gained by dynamic flow designs, preheating inlet flow streams, and use of a catalyzing

agent. The evolution of available O2 was as high as 85% for 4-hour mission configurations and as high as 98% for 24-hour missions. The superoxide configurations that were developed are in plate form as opposed to discs since the former have more efficient O2 generation and CO2 absorption characteristics. The configurations feature rippled superoxide plates, which, when packaged, achieve a 20% increase in bulk density over granules, and a lower pressure drop, thereby minimizing fan power. Heat generated by the superoxide reaction was utilized in the following manner: the inlet flow stream was preheated by refluxing a part of the outlet stream with it. Effects of humidity, reduced pressure, O2/N2 balance and densification of solid forms on the mass transfer behavior of the superoxide configurations are described. TAB

N67-24923*# Kentucky Univ., Lexington.
SENSIBLE HEAT TRANSFER IN THE GEMINI AND APOLLO PRESSURE SUITS
J. E. Funk, J. B. Moegling, R. M. Drake, Jr., J. F. Hall, Jr., F. K. Klamm et al Wright-Patterson AFB, Ohio, AMRL, Dec. 1966 94 p refs
(Contract AF 33(615)-3370)
(NASA-CR-83744; AMRL-TR-66-173; AD-647828) CFSTI: HC $3.00/MF $0.65 CSCL 06K

The results of an experimental program to determine sensible heat transfer effects in the Gemini and Apollo pressure suits are reported. A copper manikin maintained at a constant surface temperature was used and the overall average body surface heat flux and the regional heat flux distribution were measured. The environmental variables studied were ventilating air flowrate, velocity of the air moving over and around the outside surface of the suit, and prevailing pressure. In addition, the following determinations were made: the heat transfer coefficient between the manikin surface and the ventilating air, the overall thermal conductance between the ventilating air and the air moving over the outside surface of the suit, the thermal emissivity of the Gemini suit, and the convection coefficient between the outside surface of the Gemini suit and the air moving over the outside of the suit. These data may be used for heat balances, determination of temperatures, and evaluation of the insulation value of the suit and outside air. The insulation value for the air ambient to the Gemini suit was found to follow a relationship different from the empirical equation for a nude manikin. Author (TAB)

N67-24933# Columbia Univ., New York. Teachers Coll.
STRATEGIES OF INDUCING COOPERATION: AN EXPERIMENTAL STUDY
Morton Deutsch, Yakov Epstein, Donnah Canavan, and Peter Gumpert 10 Feb. 1967 31 p refs
(Contract Nonr-4294(00))
(TR-5; AD-647801) CFSTI: HC $3.00/MF $0.65

Ss played a two-person laboratory game in which they could act altruistically, individualistically, defensively, or aggressively. Ss did not interact with a real person, but 5 programmed strategies were employed to see which was most effective in eliciting cooperation from a non-cooperative S. The strategies were: Turn The Other Cheek - the program responded to a threat or an attack by an altruistic choice and with a cooperative choice otherwise; Nonpunitive - the program responded defensively rather than with counter-threats or counter attacks when the S threatened or attacked, and reciprocated the rest of the Ss behavior; Deterrent - the program responded with a threat to any noncooperative act of the S, counter attacked when the S attacked and responded cooperatively to any cooperative behavior from the S; two types of Reformed Sinner strategy - in both the program responded with threats and aggression for the first 15 trials of the game and then changed dramatically on the 16th trial by disarming. In one form of the Reformed Sinner the program followed the Turn The Other Cheek strategy, and in the other the program became Nonpunitive. Results are consistent with findings of other investigators. Ss behaved most competitively during the 15 trials of the Reformed Sinner condition when the program was threatening and aggressive; Ss tended to exploit in the Turn The Other Cheek condition; Ss behaved most cooperatively in the Nonpunitive condition. Author (TAB)

N67-24996# Illinois Univ., Urbana. Group Effectiveness Research Lab.
LEADERSHIP STYLE AND THE PERFORMANCE OF CO-ACTING GROUPS
Fred E. Fiedler Oct. 1966 28 p refs
(Contract Nonr-1834(36); ARPA Order 454)
(TR-44; AD-647212) CFSTI: HC $3.00/MF $0.65

This paper reviews several studies of co-acting groups, that is, groups in which members typically do not interact with one another in performing a common task. While relatively few data are available, they are quite consistent in showing that the task-oriented (low LPC) leader tends to perform better in situations which are relatively pleasant and free from anxiety while the relationship-oriented leader of co-acting groups tends to perform better in situations in which tension or anxiety is relatively high. These findings are discussed in terms of group member requirements for quasi-therapeutic interactions which typically provide little psychological group support for the individual member. TAB

N67-25049*# General Technical Services, Inc., Yeadon, Pa.
ANATOMY AND DC CHARACTERISTICS OF THE ARTERIAL SYSTEM WITH AN INTRODUCTION TO ITS AC CHARACTERISTICS
A. S. Iberall Washington, NASA, May 1967 28 p refs
(Contract NASw-1066)
(NASA-CR-770) CFSTI: HC $3.00/MF $0.65 CSCL 06P

Three topics relating to the physics of the arterial system are discussed: the quantitative anatomy, geometry, and topology; the calculation of average peripheral resistance; and the pulsatile flow (AC) characteristics of the system. An updated version of Green's tabulation of arterial parameters is presented; the table is shown to be consistent in its geometric properties with the DC resistance characteristics of the arterial bed, and the internal volume available to blood. An important application of the internal geometry of the arterial system is considered to be the development of the transmission dynamics of AC flow. The actual regulated state of the terminal resistance found in clinical observation is also discussed. M.G.J.

N67-25073*# Michigan Univ., Ann Arbor. Dept. of Psychology.
OPTIMAL LEARNING IN DETECTION SITUATIONS Semiannual Status Report
Wilson P. Tanner, Jr. Apr. 1967 7 p refs
(Grant NGR-23-005-159)
(NASA-CR-66350; Rept.-07814-2-P) CFSTI: HC $3.00/MF $0.65 CSCL 05H

The main ideas behind two distinct models that have been proposed to describe pre-asymptotic changes in performance are presented. It is pointed out that in a simple detection task the input conditions to the observer have been generated under two experimental manipulations. The task of the observer is to identify which of these two manipulations was performed on each trial. The first model of psychophysical learning, called the variable-bias theory, is based on the notion that the cutoff on the observer's decision axis varies from trial to trial. The second theory, or the variable sensitivity theory, states that the true likelihood ratio of sensory events is not perfectly known to the observer. The conceptual differences between the models are discussed, and it is noted that it is very difficult to obtain experimental evidence to choose between them by using current psychoacoustical procedures. Mention is also made of research being conducted in other aspects of this subject. L.E.W.

N67-25074* Massachusetts Inst. of Tech., Cambridge. Man-Vehicle Control Lab.
HELICOPTER CONTROL: A MULTI-LOOP MANUAL CONTROL SYSTEM
George R. Friedman (M.S. Thesis) Jun. 1967 112 p refs
(Grant NsG-577)
(NASA-CR-83740; MVT-67-2) CSCL 05H

The human operator's performance in a high order, multi-loop task, typified by the helicopter, is studied using the method of average responses. This method permits a time domain, transient input analysis. A cascade model configuration for the human operator is proposed. In this configuration, the first human operator model controls attitude. This model is identical to that of the single-loop model for the same dynamics and consists of a lead time constant of 5 seconds, a neuromuscular lag of .1 second, and a pure time delay of .28 seconds. The attitude reference for the attitude control loop is provided by a second cascade human operator model consisting of a one second lead operating on the position error. A general programming system for average response experiments is described. Author

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N67-23518# Chicago Univ., Ill. Inst. for the Study of Metals.
THEORETICAL AND EXPERIMENTAL STUDIES IN CHEMICAL PHYSICS Final Report
Stuart A. Rice [1967] 30 p refs
(Grant AF-AFOSR-781-65)
(AFOSR-67-0041; AD-645485) CFSTI: HC $3.00/MF $0.65

Work resulting in the following accomplishments is summarized: (1) the extension of the theory of excitons to circumstances where charge delocalization is important; (2) the development of a deeper understanding of the nature of dynamical coherence in classical many body systems and its role in transport phenomena; (3) successful completion of a set of experimental studies designed to elucidate the nature of excess electron states in very simple liquids and the development of a zeroth order theory to describe the experimental data; (4) the development of a theory of electron-atom scattering and of the Rydberg states of molecules based upon a pseudopotential approach; (5) the development of a new approximation in the equilibrium theory of liquids, its testing against experiment, and the initiation of a study of its implications for the theory of phase transitions. Author (TAB)

N67-23520# Rochester Univ., N. Y. Dept. of Chemistry.
ELECTRONIC SPECTRA OF POLYATOMIC MOLECULES Annual Summary Report
A. B. F. Duncan 1 Jan. 1967 6 p
(Contract Nonr-668-15)
(AD-644993) CFSTI: HC $3.00/MF $0.65

A summary is given of progress and results of work in the following areas: absorption of benzene to the second electronic state; lifetime of the first excited state of sulfur dioxide; absorption spectrum of carbon suboxide. TAB

N67-23543# Ohio State Univ. Research Foundation, Columbus.
SPECIFIC HEAT DETERMINATIONS OF PURE, SOLID PARA DEUTERIUM Final Report, 1 Apr. 1957–31 Aug. 1966
David White 29 Nov. 1966 7 p refs
(Contract AT(11-1)-522)
(COO-522-14) CFSTI: HC $3.00/MF $0.65

During the process of measuring heat capacity of ortho–para mixtures of solid deuterium, studies were also made on the ortho–para separation process on terms of some simple models describing the interaction of a diatomic molecule with a solid surface, and the separation of molecular hydrogens by spontaneous phase separation of liquid or solid solutions. The completion of heat capacity studies of ortho–para mixture of solid deuterium verified that the anisotropic (rotationally dependent) interactions of the diatomic molecules in the solid were principally quadrupolar and also strongly suggested that the crystal structure both above and below the λ-anomaly needed clarification. NSA

N67-23544# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
ON THE NATURE OF THE AMERICIUM-OXYGEN SYSTEM: DISSOCIATION PRESSURES, RELATED THERMODYNAMIC FUNCTIONS, AND PHASE EQUILIBRIA
Thomas David Chikalla (Ph.D. Wisconsin Univ.) Aug. 1966 180 p refs
(Contract AT(45-1)-1830)
(BNWL-CC-828; BNWL-SA-734) CFSTI: HC $3.00/MF $0.65

An isopiestic–thermogravimetric technique was used to measure the oxygen dissociation pressures over substoichiometric americium oxides at 866 to 1172°C and from one to below 10^{-8} atm O_2. The nonstoichiometric compositions encountered under these conditions covered the interval $1.80<O/Am<2.00$. The relative partial molar enthalpy and entropy of solution in oxygen in AmO_{2-x} calculated from the experimental dissociation pressures, were found to be a function of composition, but independent of temperature in the region studied. A sharp change in slope on both the $\Delta H(O_2)$ and $\Delta S(O_2)$ versus composition plots occurred at about $AmO_{1.98}$. Phase relations in the system between $1.50<O/Am<2.00$ were studied using Guinier and Debye diffraction methods on quenched and annealed samples. The cubic Am_2O_3 phase was found to be capable of dissolving excess oxygen and existed as a defect phase over the broad interval of about $1.51<O/Am<1.72$. Between $AmO_{1.72}$ and $AmO_{2.00}$ the system was diphasic and consisted of these two phases. Evidence was found for what is believed to be a new Am_2O_3 phase, which is probably monoclinic (B-type rare earth sesquioxide structure). The likelihood for existence of this phase, as well as the cubic and hexagonal Am_2O_3 phases, is discussed in terms of a rare earth/actinide oxide analogy based on considerations of ionic radii. A homologous series of substoichiometric ordered intermediate phases were looked for, but not observed. The lack of such phases in this system is thought to be the result of self-induced radiation damage caused by the alpha decay of ^{241}Am. The dependence of the weight change accompanying nonstoichiometry on the exponent of the oxygen pressure was used to consider possibilities for the defect structure of AmO_{2-x}. Author (NSA)

N67-23546# Atomic Weapons Research Establishment, Aldermaston (England).
EXCHANGE OF HYDROGEN ISOTOPES BETWEEN METHANE AND ERBIUM TRITIDE
P. M. S. Jones, P. Ellis, and C. G. Hutcheson Nov. 1966 14 p refs
(AWRE-O-93/66) HMSO: 2s 6d

The exchange of gaseous methane with an erbium tritide film was studied. The kinetics show that the rate-controlling step in the reaction was the rate of production of atomic hydrogen by methane radiolysis, primarily by gas phase tritium. Molecular hydrogen exchanged much more slowly than methane. Author (NSA)

N67-23581# Deutsche Akademie der Wissenschaften zu Berlin (East Germany).
WORKING 4th CONFERENCE ON STABLE ISOTOPES: SEPARATION, USE, AND ANALYSIS OF STABLE ISOTOPES AS WELL AS CHARACTERISTIC ISOTOPE SYSTEMS, LEIPZIG, GERMANY, OCTOBER 24–29, 1965
29 Oct. 1965 156 p In GERMAN and RUSSIAN
(CONF-651081) CFSTI: HC $3.00/MF $0.65

Summaries of papers presented at the conference are grouped under the following topics: separation of stable isotopes; analysis of stable isotopes; research on characteristics of isotope systems; use of isotope systems; stable isotopes in biology, medicine, and agriculture; and isotope geology. NSA

N67-23592# Rice Univ., Houston, Tex. Dept. of Chemistry.
MASS SPECTROMETRIC STUDIES OF SCANDIUM, YTTRIUM, LANTHANUM, AND RARE-EARTH FLUORIDES
K. F. Zmbov and J. L. Margrave Oct. 1966 58 p refs Presented at the Am. Chem. Soc. Meeting, New York
(Contract AT(40-1)-2907)
(ORO-2907-16); CONF-660907-7) CFSTI: HC $3.00/MF $0.65

A review is presented of recent mass spectrometric studies of the sublimation and vaporization processes for the rare earth trifluorides. In all cases, the vapors over condensed rare earth trifluorides are the monomeric MF_3 molecules. The rates of sublimation of the trifluorides were measured and the heats of sublimation determined by the second-law method. Mono- and difluorides of the rare earths may be produced in the vapor phase either by vaporizing the trifluorides under reducing conditions, or by oxidizing the rare earth metals with a fluorinating agent. Ionization potentials for rare earth atoms, mono- and difluorides were measured by the electron-impact method. Gaseous equilibria involving the atoms, sub-fluorides, and tri-fluorides of the various metals were studied and used to establish the bond strengths and other thermodynamic properties. The dissociation energies of the rare earth monofluorides show a correlation with atomic number, similar to that observed for the dissociation energies of monoxides and the heats of sublimation of the metals. Author (NSA)

N67-23600# Oak Ridge National Lab., Tenn.
VAPOR-LIQUID EQUILIBRIA OF THE BINARY SYSTEM URANIUM HEXAFLUORIDE–NIOBIUM PENTAFLUORIDE
Woodrow Wilson Pitt, Jr. (M.S. Thesis–Tenn. Univ.) Jan. 1967 136 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1683) CFSTI: HC $3.00/MF $0.65

The vapor–liquid equilibria of the binary system uranium hexafluoride–niobium pentafluoride were investigated. Experimental data on the isothermal dependence of total pressure and liquid phase compositions at 150°C and the isobaric dependence of boiling point on liquid composition at 5.92 atmospheres were obtained. The liquid phase concentrations ranged from 2 to 70 mole percent uranium hexafluoride. The results showed that the binary system exhibits large positive deviations from Raoult's law but does not have an azeotrope between 2 and 99.5 mole percent uranium hexafluoride (and probably does not have an azeotrope at all). The activity coefficients, corrected for nonideal vapor phase behavior may be calculated from the van Laar simplification of the four-suffix Wohl equations using the constants: $A = 0.739 - 314\,[(1/T) - 0.00236]$, $B = 1.170 - 574\,[(1/T) - 0.00236]$, and $D = 0.239$. The critical constants of niobium pentafluoride were determined experimentally to be: $T_c = 737°K$, $P_c = 62$ atmospheres, $\rho_c = 1.21\ g/cm^3$, and $z_c = 0.158$. A useful technique to correlate indirect vapor–liquid equilibrium data with various simplified forms of the Wohl equation was developed which does not require the assumption of an ideal vapor phase. The technique uses a high-speed digital computer and a modification of an existing computer program to fit the experimental data by the method of least squares to an equation or system of equations containing up to eight arbitrary constants. Author (NSA)

N67-23608# Air Force Cambridge Research Labs., Bedford, Mass. Solid State Sciences Lab.
A STUDY OF BORON HALIDE—GROUP V HALIDE COMPLEXES
A. F. Armington, J. R. Weiner, and G. H. Moates Sep. 1966 16 p refs *Its* Phys. Sci. Res. Papers, no. 267
(AFCRL-66-652; AD-645468) CFSTI: HC $3.00/MF $0.65

Attempts were made to produce Lewis acid complexes of boron triiodide, tribromide and trichloride with the triiodides, tribromides and trichlorides of phosphorus, arsenic and antimony. The experimental method used involved the combining of the reagents in carbon disulfide at reduced temperatures. Of the 27 possible complexes, only 6 were formed. Of these only 4 complexes are stable. These are boron triiodide-phosphorus triiodide, boron triiodide-phosphorus bromide, boron-tribromide-phosphorus triiodide and boron tribromide-phosphorus bromide. Boron-triiodide-phosphorus trichloride and boron tribromide-phosphorus trichloride formed, were not stable, however, and did undergo cross halogenation and decomposition. Results of this are compared with other studies for these compounds which have been prepared in the literature. Some properties of the stable complexes are evaluated qualitatively. Author (TAB)

N67-23609# California Inst. of Tech., Pasadena.
TRANSFER OF EXCITATION IN SOLUTION Final Progress Report, 1 Nov. 1964–31 Oct. 1966
George S. Hammond Dec. 1966 11 p refs
(Contract AF 49(638)-1479)
(AFOSR-67-0165; AD-645635) CFSTI: HC $3.00/MF $0.65

Work carried out on the following problems is briefly summarized: correlation of photochemical with radiation-induced reactions; study of rates of energy transfer by flash kinetic spectrophotometry; quenching of fluorescence; kinetics of photoreections effected by photosensitizers; use of electron spin resonance to study free radicals produced by ultraviolet irradiation of fluid solutions. TAB

N67-23631# Colorado Univ., Boulder.
THE SYNTHESIS OF SPECIAL FLUORINE-CONTAINING MONOMERS Semiannual Report, Jun. 1–Dec. 1, 1966
J. D. Park and J. R. Lacher 15 Dec. 1966 29 p refs
(Contract DA-19-129-AMC-869(N))
(Rept.-67-48-CM; SAR-2; AD-645432) CFSTI: HC $3.00/MF $0.65

Further work on the syntheses of fluorine containing olefins and diolefins is reported. Studies directed toward syntheses of derivatives of perfluorobicyclobutyl and perfluorobicyclobutenyl were initiated. Of particular interest is the preparation of 2,2-diiodo-perfluorobicyclobutenyl by photolysis of 1,2-diiodotetrafluoro cyclobutene. Starting from 1,2-dichlorohexafluoro cyclopentene, other dihalo- and mixed dihalohexafluorocyclopentenes were prepared, and from these were prepared the monoethoxy derivatives, such as 1-iodi-2-ethoxyhexafluoro cyclopentene. Author (TAB)

N67-23659*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PHYSICS
W. B. De More and O. F. Raper *In its* Supporting Res. and Advanced Develop. 28 Feb. 1967 p 287–292 refs (See N67-23641 12-11)

The reaction of singlet-D atomic oxygen with alkanes at 87°K is investigated, an evaluation of Coulomb integrals of continuum functions is reported, and rigid motions in conformal space-time are studied. The atomic oxygen study provides information on (1) the relative rates for attack of the singlet-D oxygen on a series of RH-type compounds and on different C—H bonds within a particular molecule, (2) the detailed mechanism of the attack on the C—H bonds, and (3) the primary products of the various reactions. In the second study, convergence is shown for a typical integral that occurs in the evaluation of the matrix element of interelectronic Coulomb energy relative to two determinantal wave functions.

Mention is made that the Herglotz–Noether theorem was proved for all conformally flat manifolds, and some other findings related to rigid motions are noted. M.W.R.

N67-23677# Research Triangle Inst., Durham, N. C. Chemistry and Life Sciences Lab.
THE SYNTHESIS OF SMALL RING COMPOUNDS CONTAINING SILICON Final Report, Jun. 1, 1965–Jan. 15, 1967
Colin G. Pitt Jan. 1967 42 p refs
(Contract Nonr-4860(00))
(AD-645879) CFSTI: HC $3.00/MF $0.65

The ring closure of 1,2-bis(chlorosilyl)ethanes with various metals, and the oxidative elimination of the hydrazo group from certain cyclic silylhydrazines, were investigated as potential syntheses of the 1,2-disilacyclobutane ring system. The fragmentation of gamma-haloalkylsilanes, the disproportionation tin-silicon compounds, halogen-metal interchange and decarbonylation of bis(silyl)ketones were briefly considered as routes to small ring compounds of silicon. The preparation of 3,3,6,6-tetramethyl-1,2-diaza-3,6-disilacyclohexane and 1-amino-2,2,5,5-tetramethyl-1-aza-2,5-disilacyclopentane is described. The two compounds are shown to be in equilibrium at room temperature even in the absence of added catalysts. The oxidation of these compounds with mercuric oxide and ethyl axodicarboxylate was studied and the oxidation products identified. The equilibration and oxidation of the acyclic analogs, N,N and N,N-bis(trimethyl-silyl)hydrazine, were similarly investigated. The reaction of a series of 1,2-bis(chlorosilyl)ethanes with magnesium is shown to result in cleavage of the tetrahydrofuran solvent. The reactions with lithium, potassium or sodium amalgam give only polymeric products. The first example of vinyl hydrogen ligand exchange at silicon, catalyzed by chloroplatinic acid, is described. Author (TAB)

N67-23685# Stanford Research Inst., Menlo Park, Calif.
SORPTION OF GASES ON METAL SURFACES IN ULTRAHIGH VACUUM Final Report, 15 Feb.–14 Aug. 1966
B. Bergsnov-Hansen, N. Endow, B. Evans, and R. A. Pasternak Sep. 1966 90 p refs
(Contract AT(04-3)-425)
(SRIA-425-9) CFSTI: HC $3.00/MF $0.65

The chemisorption of O_2 on Mo films was investigated and the sticking probability curve at 300°K is shown. The initially high sticking probability decreased continuously with coverage. When the same film was cooled to 77°K, an additional amount of only 0.7×10^{14} molecules cm^{-2} was adsorbed. The sticking probability at 77°K was virtually independent of coverage. Studies on H_2-D_2 exchange on Mo surfaces and O_2 adsorption on Nb are also reported. NSA

N67-23695# Isochem, Inc., Richland, Wash.
TECHNICAL CRITERIA FOR THE PREVENTION OF CRITICALITY, CHEMICAL PROCESSING DIVISION
R. E. Tomlinson and G. R. Kiel 14 Oct. 1966 8 p ref
(Contract AT(45-1)-1851)
(ISO-522) CFSTI: HC $3.00/MF $0.65

Technical criteria to be used in developing the limits within which chemical processing facilities are to be designed and operated are defined. The intent of these criteria is to maintain the risk of criticality at the lowest level that can be achieved at a cost that is considered reasonable relative to the risk involved. These criteria are based on the operating experience accumulated in 22 years of processing fissile materials. NSA

N67-23696# Aerojet-General Nucleonics, San Ramon, Calif.
FISSIOCHEMICAL DEVELOPMENT PROGRAM Final Report
John H. Cusack and Paul A. King Aug. 1966 264 p refs
(Contract AT(04-3)-596)
(AGN-8196, Vol. 2) CFSTI: HC $3.00/MF $0.65

Results are reported for studies on: fissiochemical nitrogen fixation; fission fragment radiolysis of carbon dioxide; selection, technology, and irradiation of new chemical systems; and process design and application analysis. In a Factorial Block Experiment (FBX) on fissiochemical nitrogen fixation, G(HCN) increased with increasing temperature and decreased with decreasing flow (increasing dose), increasing pressure (decreasing dose rate), and high CH_4 concentrations. Addition of water vapor, helium, or mixed CH_4 radiolysis products had little effect on G(HCN) or G(CH_3CN), while addition of NH_3 decreased yield. An analytical scheme was developed for measuring the ^{14}C activity in trap-collected quantities of fissiochemically produced HCN. In the presence of NO_2, G(CO) ranged as high as 12 in the fission fragment radiolysis of CO_2. The addition of up to 15% CH_4 did not significantly alter CO yield. From a mechanistic point of view, the fission fragment irradiation of CO_2 is apparently a track effect involving the polymerization of CO_2 ions followed by neutralization, producing more than one molecule of CO per ion. Analysis techniques were developed to permit quantitative measurements of hundreds of specific products in radiolysis systems. Preliminary analyses of an HCN production are described. NSA

N67-23697# Aerojet-General Nucleonics, San Ramon, Calif.
FISSIOCHEMICAL DEVELOPMENT PROGRAM Final Report
John H. Cusack and Paul A. King Aug. 1966 296 p refs
(Contract AT(04-3)-596)
(AGN-8196, Vol. 1) CFSTI: HC $3.00/MF $0.65

Developments concerned with the use of fission fragment energy to bring about chemical reactions of interest are summarized. While the depth and breadth of the understanding of fission fragment physical behavior, track effects, chemical reactions amenable to fissiochemical induction, etc., were significantly extended, no single fuel/product combination can yet be shown to have strong economic potential using current industrial forecasting techniques. Typical of the accomplishments during the program are: differential absorber experiments using silicon surface barrier detectors were combined with theory, empiricism, and sophisticated computer approaches, to allow the derivation of general fission fragment range-energy equations and the determination of energy deposition efficiencies for a diversity of solid fuel compositions and shapes. A new family of proprietary ceramic and metallic fibrous fuels were developed and evaluated; the most promising of the compounds with the solid solution, ZrO_2–UO_2, although its radiation and physical stability must be improved before it is fully qualified for reactor use. A number of related basic radiation chemistry investigations were conducted. Most involved nitrogen or ethylene; pressure and track effects were particularly stressed. Based on the ^{60}Co, e^-, and fission fragment radiolysis of ethylene, it was found that electronically excited reactions are only slightly affected by pressure or LET and that increasing LET increases radical–radical reactions and decreases ionic reactions. The use of scavengers to react with radiolytically produced free radicals or ions in a fission track seems destined to be inefficient. A gas-phase fissiochemical loop has been operated in the Union Carbide 5 MW reactor for the past 3 years. Most operations involved the N_2–CH_4 system; HCN yield varied directly with temperature and flow and inversely with pressure and CH_4 concentration. Maximum G(HCN) was about 3 molecule/100 eV at 400°C. Moderate to severe solid product formation was experienced. All ^{14}C formed from $^{14}N(n,p)^{14}C$ was incorporated in the product as $H^{14}CN$. Preliminary process design and analysis indicated the fissiochemical production of HCN to be economically marginal at best. Loop irradiation of CO_2 and CO_2–CH_4 mixtures indicated G(CO) as high as 10, representing a radiation-to-chemical energy conversion of about 29%. Although the conclusions emerging from a comprehensive experimental survey of potentially economic fissiochemical reactions were not highly encouraging, an unexpected reaction between CO and H_2 was discovered. The resulting solid product could be induced by ^{60}Co, mixed reactor (n,γ), and high frequency microwave discharge

radiation as well as by fission fragments. Maximum G(N) was about 3 and maximum nitrogen incorporation more than 30% w.
Author (NSA)

N67-23721# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
SYNTHESIS OF 102 ISOTOPES WITH MASS NUMBERS 256 AND 255 IN REACTIONS INDUCED BY O IONS [SINTEZ IZOTOPOV 102 ELEMENTA S MASSOVYMI CHISLAMI 256 I 255 V REAKTSIYAKH S IONAMI KISLORODA]
G. N. Flerov, S. M. Polikanov, V. L. Mikheev, V. I. Ilyuschchenko, V. F. Kushniruk et al 1966 13 p refs In RUSSIAN
(JINR-P7-3059) CFSTI: HC$3.00/MF$0.65

In bombarding ^{242}Pu with ^{18}O ions, the following isotopes $^{256}102$ ($T_{1/2}=9\pm3$ sec, $E_\alpha=8.42\pm0.03$ MeV) and $^{255}102$($T_{1/2}=180\pm40$ sec, $E_\alpha=8.09\pm0.03$ MeV) were synthesized. They were identified by excitation functions in nuclear reactions. The results obtained are in good agreement with those obtained in bombarding ^{238}U with ^{22}Ne.
Author (NSA)

N67-23730# Carnegie Inst. of Tech., Pittsburgh, Pa. Dept. of Chemistry.
T-129 AS A GEOCHEMICAL AND ECOLOGICAL TRACER Progress Report, 1 Dec. 1965–31 Oct. 1966
Truman P. Kohman and Raymond R. Edwards 30 Nov. 1966 43 p refs
(Contract AT(30-1)-3624)
(NYO-3624-1) CFSTI: HC$3.00/MF$0.65

Studies were made to exploit the natural occurrence of the longlived ^{129}I (half-life 1.6×10^7 years) expected from spontaneous and induced fission of uranium and from cosmic-ray interactions with the atmosphere, meteorites, and similarly exposed materials, and the somewhat larger quantities introduced into the environment through atomic energy activities. A substantial number of samples of biological, mineral, and commercial iodine-bearing materials, including some collected or processed before 1945, have been acquired. Chemical procedures for pre-irradiation isolation of iodine and post-irradiation preparation for counting have been adapted to the analytical specimens of interest. Many of the specimens have been processed to varying extents. Conditions have been established for the use of an existing γ–γ coincidence detector system for the assay of ^{129}I in relatively large (≈gram) samples of iodine, and partially tested following four irradiations of natural and synthetic samples. Specifications have been formulated for a β–γ coincidence system for the assay of ^{129}I in very small amounts in small (≈mg) samples of iodine.
NSA

N67-23738 Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
INFRARED DETERMINATION OF RESIDUAL HYDROGEN IN DEUTERATED INORGANIC COMPOUNDS
T. L. Whateley and R. N. Whittem May 1966 8 p refs
(AAEC-TM-326) CFSTI: HC$3.00/MF$0.65

An accurate infrared spectroscopic method of determining traces of H_2O in high-purity D_2O was used to estimate H_2O in compounds containing both H_2O and D_2O, and exchangeable hydrogen in compounds containing both hydrogen and deuterium.
Author (NSA)

N67-23739# Polytechnic Inst. of Brooklyn, N.Y. Inst. of Polymer Research.
SOLID STATE POLYMERIZATION INITIATED BY IONIZING RADIATION Final Report, 1 Jun. 1954–1 Aug. 1966
Herbert Morawetz 1 Aug. 1966 12 p refs
(Contract AT(30-1)-1715)
(NYO-1715-16) CFSTI: HC$3.00/MF$0.65

Studies on solid state gamma radioinduced polymerization of such compounds as acrylamide, calcium and sodium acrylates, butadiene-1-carboxylic acid, methacrylic acid, p-benzamidostyrene, and vinyl stearate are discussed. A particularly fruitful line of study resulted from the observation that acrylamide forms solid solutions with propionamide. The presence of the saturated analog had surprisingly little effect on the polymerization velocity, but it reduced, even at quite low concentration, the chain-length of the polymer obtained.
NSA

N67-23740# Brandeis Univ., Waltham, Mass. Dept. of Chemistry.
EFFECTS OF MERCAPTANS AND DISULFIDES ON PHOTOCHEMICAL AND HIGH ENERGY RADIATION INDUCED REACTIONS
Saul G. Cohen 1 Nov. 1966 19 p refs
(Contract AT(30-1)-2499)
(NYO-2499-20) CFSTI: HC$3.00/MF$0.65

The proposed mechanism of inhibition of photochemical and radioinduced reactions by mercaptans involves rapid transfer of hydrogen atom from mercaptan to an intermediate radical and from an intermediate radical to thiyl radical. In the benzophenone–2-propanol system the intermediate radicals, $(C_6H_5)_2\dot{C}OH$ (I) and $(CH_3)_2\dot{C}OH$ (II) are reconverted to the starting materials, benzophenone and 2-propanol, respectively, inhibition resulting. This mechanism would require that if the radicals I and II were formed from benzhydrol and acetone they would still be converted by the sulfur compounds to benzophenone and 2-propanol. Inhibition would not result but the system would be transformed. This has been demonstrated confirming the mechanism of action of sulfur compounds. Additional experiments have been carried out on the photoreduction of aminobenzophenones in acidic aqueous 2-propanol. Photoreduction at 313 mμ of p-dimethylaminobenzophenone in 1:1 2-propanol–water, 6N in HCl, led to the pinacol with quantum yield ≈0.3. Photoreduction of 4-benzoylphenyltrimethylammonium chloride at 303 mμ in 1:1 2-propanol–water led to the pinacol with quantum yield = 0.64. Other water soluble ketones, such as 4-benzoylbenzoic and benzophenone are also being studied. Photoreduction of the sodium salt of 4-benzoylbenzoic acid studied in 1:1 2-propanol as a function of pH. Preliminary results indicated that a tertiary amine is an excellent photoreducing agent for 4-benzoylbenzoic acid in aqueous medium, although the tertiary amine is not very effective in photoreduction of benzophenone in benzene. Sodium 4-benzoylbenzenesulfonate was synthesized. It is photo-reduced in aqueous 2-propanol, quantum yield ≈1.1. The photoreduction is quenched by naphthalene, less effectively by 1-naphthyltrimethylammonium tosylate, and still less effectively by 2-naphthylsulfonic acid. The photoreduction of p-aminobenzophenone by diisopropylamine showed quantum yield ≈0.02 and led to the pinacol. The photoreduction of p-aminobenzophenone by triethylamine was remarkably effective, quantum yield = 0.45 at 10^{-3}M ketone. The reaction was unusual, being less effective at higher concentration of ketone and more effective at high intensity of light.
NSA

N67-23746# Dow Chemical Co., Denver, Colo. Rocky Flats Div.
DISSOLUTION OF PLUTONIUM-BEARING RESIDUES IN A NITRIC ACID-CALCIUM FLUORIDE SOLVENT SYSTEM
G. F. Molen and R. O. Wing 22 Nov. 1966 22 p refs
(Contract AT (29-1)-1106)
(RFP-776) CFSTI: HC$3.00/MF$0.65

The dissolution of plutonium-bearing residues in a nitric acid-calcium fluoride solvent system is described. The length of the reflux period, the drying temperature of heels, the solid to liquid ratio, the addition of fluoride during dissolution, and the effectiveness of a multiple contact system are evaluated in terms of the effects they have on the dissolution of these residues.
Author (NSA)

N67-23758# Iowa State Univ. of Science and Technology, Ames.
CHROMATOGRAPHIC SEPARATIONS OF NIOBIUM, TANTALUM, MOLYBDENUM, AND TUNGSTEN
Lionel Herbert Dahmer (Ph.D. Thesis) Nov. 1966 79 p refs
(Contract W-7405-ENG-42)
(IS-T-113) CFSTI: HC $3.00/MF $0.65

Molybdenum, tungsten, niobium, and tantalum were quantitatively separated by cation exchange from many other metal ions. In the presence of excess peroxide in acidic solution, these four metal ions form anionic peroxy complexes which are not retained by cation exchange resin. Recoveries for molybdenum and other metal ions were about 99.8%. A partition chromatographic method for separation of niobium, tantalum, molybdenum, and tungsten from each other was developed by adapting the hydrochloric acid, hydrofluoric acid–methyl isobutyl ketone system to a column. Batch distribution ratios were determined for the metal ions from various combinations of hydrochloric, hydrofluoric, and sulfuric acid into methyl isobutyl ketone. Tantalum, niobium, and molybdenum were highly extracted from a 7 M hydrochloric to 2 M hydrofluoric acid solution, while tungsten had a low distribution ratio. The separations and radiochemical determinations of trace quantities of the four metals were very successful. Quantitative recovery was also obtained in the separation of one part of radioactive molybdenum from 10^8 parts each of tantalum, niobium, and tungsten. NSA

N67-23760# Iowa State Univ. of Science and Technology, Ames.
CORRELATION OF THERMODYNAMIC DATA WITH BINARY EUTECTIC-TYPE PHASE DIAGRAMS
Michael Fred Simmons (Ph.D. Thesis) Nov. 1966 92 p refs
(Contract W-7405-ENG-42)
(IS-T-123) CFSTI: HC $3.00/MF $0.65

An evaluation has been made of various empirical equations in order to determine their feasibility in describing thermodynamic properties of salt and metal systems. Computer programs have been written and employed for the determination of parameters in the empirical equations. The systems to which the empirical equations were applied are KCl–LiCl, LiCl–RbCl, AgCl–RbCl, AgCl–KCl, Bi–Cd, and Cd–Zn. These systems were chosen because they are simple binary eutectic systems and because necessary thermodynamic data for the pure components and enthalpy of mixing data are available for each of them. Comparison of empirical with experimental enthalpy of mixing data was the primary basis for evaluation. Of the empirical equations considered in this investigation, an equation of the form $\Delta F_i^{-xs} = (a+bN_i^n)(1-N_j)^2$, where $a = \alpha + \beta T$ and $b = \alpha + \beta' + \beta' T$, was found to be the most applicable. A method for determining the parameters a, b, and n based upon minimum relative standard deviation in the α, β, α', and β' parameters and involving ΔS_i^{-xs} and ΔH_i quantities appeared to be the best approach for future investigations. Author (NSA)

N67-23924# Frankford Arsenal, Philadelphia, Pa. Quality Assurance Directorate.
CONDUCTOMETRIC DETERMINATION OF GRAPHITE IN PROPELLANTS BY USE OF LECO CONDUCTOMETRIC CARBON DETERMINATOR
George Norwitz and Herman Gordon Dec. 1966 31 p refs
(FA-T67-5-1; AD-645240) CFSTI: HC $3.00/MF $0.65

A conductometric method is proposed for the determination of graphite in propellants. The method is applicable to the macro and semi-micro range. A 0.02 to 0.3 gram-sample is dissolved in 10 ml of nitric acid by heating on the steam bath. If tin is present, 3 drops of hydrofluoric acid are added to prevent the precipitation of metastannic acid and occlusion of organic matter. The solution is filtered through a small Gooch crucible wrapped in aluminum foil to prevent contamination by tarry matter from the adapter. The Gooch is washed with hot dilute nitric acid (1 to 1), water, acetone, and water in that order. It is then heated at 900 - 1000C. in a ceramic tube in a current of oxygen and the carbon dioxide is determined conductometrically using a Leco Conductometric Carbon Determinator. Such factors as the best means for dissolving the sample, possible segregation, preparation of calibration curve, time for combustion, mechanism of the combustion, and interferences are considered. Author (TAB)

N67-23929# Harvard Univ., Cambridge, Mass. Dept. of Chemistry.
THE MICROWAVE SPECTRUM OF PIVALALDEHYDE
A. M. Ronn and R. C. Woods, III 14 Jul. 1966 28 p refs
(Contract Nonr-1866(14))
(AD-645777) CFSTI: HC $3.00/MF $0.65

The microwave spectrum of pivalaldehyde ($(CH_3)_3CCHO$) was investigated in the frequency region 9-40 kMc/sec. The ground state, first and second excited states of the t-butyl torsion, and the first excited state of each of the three methyl torsions were assigned. The barrier to internal rotation of the t-butyl top was calculated from the splittings in the first excited state to be 1186 cal/mole, from the splittings in the second excited state to be 1176 cal/mole, and from the intensities of the first excited state relative to the ground state to be 1100 cal/mole. The excited states of the methyl torsions show no splittings, but the relative intensities yield barrier estimates of 2600 cal/mole, 3500 cal/mole, and 3800 cal/mole, if one assumes that the three tops are independent. On the basis of certain analogies with previously investigated molecules the lowest of these barriers is very tentatively assigned to a methyl group which is eclipsed with respect to the oxygen atom. The dipole moment components were computed from Stark effect measurements to be mu-a = 2.56 D and mu-b = 0.76 D. Author (TAB)

N67-23930# Harvard Univ., Cambridge, Mass. Mallinckrodt Chemical Labs.
A GENERAL PROGRAM FOR THE CALCULATION OF INTERNAL ROTATION SPLITTINGS IN MICROWAVE SPECTROSCOPY. II: THE n-TOP PROBLEM
R. C. Woods [1963] 21 p refs
(Contract Nonr-1866(14))
(AD-645780) CFSTI: HC $3.00/MF $0.65

The internal axis method is extended to treat the effects of internal rotation in the microwave spectra of molecules with several internal symmetric tops. As a first approximation the method ignores all top-top coupling and assumes that the potential for each top is purely sinusoidal. An arbitrary number of tops is first considered and then specialization is made to the most important case, the ground state of a molecule with two equivalent tops, which turns out to be extraordinarily simple. Finally, the refinement of the method which takes the top-top coupling into account is considered. Author (TAB)

N67-23931# Hull Univ. (England). Dept. of Chemistry.
KINETICS OF HYDROGEN–OXYGEN AND HYDROCARBON–OXYGEN REACTIONS Final Report, Jun. 1965–Oct. 1966
R. R. Baldwin and R. W. Walker Oct. 1966 16 p refs
(Grant AF-EOAR-65-68)
(AFOSR-67-0381; AD-646850) CFSTI: HC $3.00/MF $0.65

The report summarizes progress made on four main topics: (a) the use of computer programmes to interpret the hydrogen-oxygen and carbon monoxide-hydrogen-oxygen reactions; (b) the oxidation of methane in slowly reacting hydrogen-oxygen mixtures; (c) the addition of neopentane to slowly reacting hydrogen-oxygen mixtures; (d) the oxidation of propionaldehyde in aged boric-acid-coated vessels. The interpretation of the results obtained and the evaluation of velocity constants from the results are discussed. Author (TAB)

N67-23986 Chemical Lab. RVO-TNO, Rijswijk (Netherlands).
THE PERMEABILITY OF PLASTIC FILMS AND FOILS TO GASES, VAPOURS AND LIQUIDS

P. T. van Raaij and P. Winkel 1966 39 p refs
(Rept.-1966-16; TDCK-46849)

The basic theories on permeability of thin macromolecular films to small molecules are described. Attention is paid to the factors affecting permeation, such as temperature and pressure, chemical nature and geometry of diffusing substance, and chemical nature and molecular structure of the polymer films. The use of laminates for special purposes is mentioned. Author

N67-24002# Rutgers Univ., New Brunswick, N. J. School of Chemistry.
REACTIONS OF NH_3 WITH POROUS GLASS SURFACES
M. J. D. Low, N. Ramasubramanian, and V. V. Subba Rao 1 Feb. 1967 24 p refs
(Contract Nonr-404(19))
(TR-4; AD-646285) CFSTI: HC $3.00/MF $0.65

Infrared spectra of NH3 sorbed on highly dehydroxylated, deuterated, and fluoridated porous glass were recorded. Two pairs of bands at 3409 and 3320/cm and at 3350 and 3308/cm were attributed to physically adsorbed NH3, hydrogen-bonded to the Si-OH and B-OH groups of the glass surface, resp. Bands at 3368 and 3282/cm were ascribed to a triple bond B:NH3 complex. Two pairs of bands at 3569 and 3479/cm and at 3543 and 3459/cm were ascribed to =B-NH2 and triple bond Si-NH2 groups, resp. A single band at 3455/cm was tentatively assigned to the N-H stretching vibration of a secondary amine, the nitrogen atom being bonded to two surface boron atoms. Author (TAB)

N67-24009# Aberdeen Proving Ground, Md. Army Coating and Chemical Lab.
CHEMICAL ASPECTS OF OXIDATION RESISTIVITY OF HYDRAULIC BRAKE FLUIDS. A STUDY OF 3-METHOXY BUTANOL-2 Interim Report
Jules B. Counts Nov. 1966 19 p refs
(CCL-217; AD-646223) CFSTI: HC $3.00/MF $0.65

The object of the investigation was to synthesize 3-methoxy butanol-2 and to characterize its properties. The structure was elucidated on the basis of stereoisomerism and infrared measurements. The interrelation with hydraulic brake fluid stability is demonstrated. Author (TAB)

N67-24014# Picatinny Arsenal, Dover, N. J. Explosives Lab.
COMPILATION OF NEUTRON SPECTRA OF SOLIDS AND LIQUIDS
H. P. Boutin, H. J. Prask, and S. Trevino Dec. 1966 183 p refs
(PA-TR-3388; AD-644945) CFSTI: HC $3.00/MF $0.65

This is a compilation of neutron spectra of 116 organic and inorganic substances taken with the slow chopper time-of-flight spectrometer. A short resume of neutron scattering theory is given in the first part followed by the description of the experimental setup. Some characteristics of the samples studied and the various vibrational frequencies obtained for each sample are assembled in 28 tables. The figures represent the neutron spectra plotted on a time-of-flight basis and/or the frequency distribution extracted from the corresponding neutron spectrum. Author (TAB)

N67-24033# Royal Aircraft Establishment, Farnborough (England).
THE POTENTIOMETRIC DETERMINATION OF FLUORIDE WITH LANTHANUM NITRATE AND ITS APPLICATION TO THE MICRO-DETERMINATION OF FLUORINE IN ORGANIC COMPOUNDS
B. F. Cheesman and J. R. Webb Oct. 1966 17 p refs
(RAE-TR-66340) CFSTI: HC $3.00/MF $0.65

The unbuffered fluoride solution is adjusted to pH 6.3 and titrated with 0.05N lanthanum nitrate solution. A rapid decrease in pH at the end-point, due to hydrolysis of the excess of lanthanum ions, is followed with a quinhydrone indicator/calomel reference electrode system. Sulphate, phosphate, carbonate, and silicate ions interfere. Methods for removal of all but the first of these are described. The method has been applied to the determination of fluorine in organic compounds. Results were within 0.5% absolute. Author (ESRO)

N67-24051# Pennsalt Chemicals Corp., King of Prussia, Pa. Research and Development Dept.
PHTHALOCYANINATO(2-)CHROMIUM(III) PHOSPHINATES
E. G. Meloni, L. R. Ocone, and B. P. Block Jan. 1967 10 p refs Submitted for publication
(Contract Nonr-2687(00))
(TR-52; AD-645886) CFSTI: HC $3.00/MF $0.65

Chromium phthalocyanine (CrPc) was obtained from the reaction of phthalonitrile with Cr(CO)6. CrPc, which converts to CrPcOH upon exposure to air, proved to be a very useful intermediate for the preparation of Chromium (III) phthalocyanine phosphinates. Attempts to find evidence of polymeric forms V by chemical means were unsuccessful of the phosphinates. TAB

N67-24151# Los Alamos Scientific Lab., N. Mex.
THE SOLUBILITIES OF SELECTED ELEMENTS IN LIQUID PLUTONIUM. X: THULIUM
D. F. Bowersox and J. A. Leary 21 Dec. 1966 10 p refs
(Contract W-7405-ENG-36)
(LA-3623) CFSTI: HC $3.00/MF $0.65

The reversibility of the Tm–Pu system was established at low Tm concentrations, and the solubility values for Tm in liquid Pu were determined from 700 to 1000°C. The solubility, which was measured in both CaF_2 and Ta crucibles, increased from 1.67% Tm (by weight) at 700°C to 6.15% Tm at 1000°C. The equation $\log N_{Tm} = 0.736 - 2.28 \times 10^3\ T^{-1}$, where N_{Tm} is the solubility expressed as the mole fraction and T is the temperature in °K, fits the data in the temperature range studied. Author (NSA)

N67-24152# Union Carbide Corp., Oak Ridge, Tenn. Gaseous Diffusion Plant.
THE MOLAL FREEZING POINT DEPRESSION CURVE OF URANIUM HEXAFLUORIDE AND ITS APPLICATION TO A METHOD OF ANALYSIS
W. D. Hedge 17 Jan. 1967 27 p refs
(Contract W-7405-ENG-26)
(K-1667) CFSTI: HC $3.00/MF $0.65

The freezing point curves for the binary systems UF_6–trichloroheptafluorobutane ($C_4Cl_3F_7$), UF_6–perfluorodimethyl cyclohexane (C_8F_{16}), and UF_6–dichlorotetrafluoro ethane ($C_2Cl_2F_4$) were determined over the ranges from 0 to 2.5 mole % of the individual solutes in uranium hexafluoride. In addition, the UF_6–HF system as determined by Wertz and Hedge was included on a molal basis. The observed molal freezing point depressions produced constants of 19.4, 19.6, 19.2, and 18.8°C per mole of solute added to 1000 grams of uranium hexafluoride, respectively. The average of these constants, 19.2 ± 0.7, is the molal freezing point constant. The deviations resulting from non-ideality are discussed. Corrections for these deviations are applied by extension of observed freezing point depressions and ratio of liquid volume to total volume. A method is introduced whereby the individual gross, liquid, and vapor compositions of the binary systems at their triple points may be estimated. Author (NSA)

N67-24160# Oak Ridge National Lab., Tenn.
Pu^{238} PRODUCTION BY A CONTINUOUS PROCESS
F. T. Binford and W. A. Hartman Jan. 1967 50 p refs
(Contract W-7405-ENG-26)
(ORNL-4023) CFSTI: HC $3.00/MF $0.65

A method for the production of Pu^{238} by the continuous irradiation and chemical processing of Np^{237} is described. Equations showing the interrelation of the various process variables, including

production rate, efficiency of Np^{237} utilization, and product quality, are developed. It is shown that in principle Pu^{238} can be produced in currently available neutron fluxes at reasonably high production rates with better than 90% efficiency of Np^{237} utilization and very high product purity. Author (NSA)

N67-24317# Library of Congress, Washington, D. C. Aerospace Technology Div.
ATRANES
Seraphim Parandjuk *In its* Foreign Sci. Bull., Vol. 3, No. 3 Mar. 1967 p 65–117 refs (See N67-24312 12-23)

A review is presented of the synthesis, structure, properties, and application of a new class of coordination compounds, derivatives of triethanolamine, called "atranes". Author

N67-24406# Picatinny Arsenal, Dover, N. J. Ammunition Engineering Directorate.
EVALUATION OF ASSAY METHODS FOR AMMONIUM PERCHLORATE
Milton Roth Dec. 1966 43 p *Its* ICRPG Round Robin No. 28
(PA-TR-3498; AD-645935) CFSTI: HC$3.00/MF$0.65

A round robin was conducted for the purpose of evaluating three assay methods for ammonium perchlorate, an important component for many solid rocket propellants. Eleven government and commercial laboratories submitted quadruplicate analyses for two different samples. These results were subjected to statistical analysis-of-variance to estimate the significance of interlaboratory variation. It was found that the laboratories were unable to obtain agreement regardless of the methods used. Author (TAB)

N67-24408# Air Force Cambridge Research Labs., Bedford, Mass. Solid State Sciences Lab.
SOME FACTORS AFFECTING THE GROWTH OF BETA SILICON CARBIDE
Charles E. Ryan, Irvin Berman, Robert C. Marshall, Dennis P. Considine, and John J. Hawley Sep. 1966 23 p refs Presented at the Intern. Conf. on Crystal Growth, Boston, 23 Jun. 1966 *Its* Phys. Sci. Res. Paper No. 266
(AFCRL-66-641; AD-645469) CFSTI: HC$3.00/MF$0.65

The report discusses the growth of beta silicon carbide by the hydrogen reduction of methyl trichlorine onto carbon substrates at 1500C. It is shown that alpha inclusions present are the rare 2H (Wurtzite) modification of silicon carbide and that their presence resulted from a vapor-liquid-solid growth mechanism which was dominated by impurities in the substrate. By carefully cleaning the substrate and purifying the methyltrichlorosilane, the alpha inclusions were eliminated. The 2H alpha crystals were then deliberately grown by introducing selected impurities locally on the substrate. Beta crystals were also intentionally grown by the vapor-liquid-solid technique by introducing appropriate impurities. Growth of beta silicon carbide from the melt is also briefly discussed. Author (TAB)

N67-24411# Olin Mathieson Chemical Corp., New Haven, Conn. Chemical Group.
1,2-BIS(SUBSTITUTED)-O-CARBORANE COMPLEXES. II. NICKEL(II) AND COBALT(II) COMPLEXES DERIVED FROM THE LIGAND 1,2-BIS(MERCAPTO)-O-CARBORANE
Hampton D. Smith, Martin A. Robinson, and Stelvio Papetti Feb. 1967 21 p refs Submitted for publication
(Contract Nonr-3395(00))
(TR-35; AD-647810) CFSTI: HC$3.00/MF$0.65

Some nickel(II) and cobalt(II) salts have been found to react readily with 1,2-bis(mercapto)-o-carborane in the presence of stabilizing phosphorous ligands or the tetraethylammonium cation to yield square planar MS_2P_2 and $MS_4(2)$ complexes. Electronic spectra of the nickel complexes are discussed. Author (TAB)

N67-24417# Brown Univ., Providence, R. I.
ELECTRIC CHARGE ON DISLOCATION ARRAYS IN SODIUM CHLORIDE
R. J. Schwendfier, Jr. and C. Elbaum Dec. 1966 27 p refs
(Contract Nonr-562(27))
(AD-647737) CFSTI: HC$3.00/MF$0.65

The electric charge on dislocation arrays was studied as a function of temperature by observing the displacement of pure tilt low angle grain boundaries in sodium chloride bicrystals maintained in an electric field. The sign of the charge was determined unambiguously by direct observation of the boundary displacement relative to the polarity of the electric field; the existence of an isoelectric point was confirmed. No measurable boundary displacement is found below a certain (threshold) value of electric field which depends on temperature. For larger fields boundary migration is observed to occur with no delay in time and at a uniform rate which increases monotonically with increasing field. The method used permits the determination of the driving force on the boundary and of the migration velocity as two independent quantities; from the temperature dependence of the boundary mobility thus determined an activation energy for the process was obtained. Author (TAB)

N67-24418# Brown Univ., Providence, R. I.
THE FORMATION OF DISLOCATION NETWORKS IN GALLIUM SINGLE CRYSTALS
S. M. McFarlane, III and C. Elbaum Dec. 1966 27 p refs
(Contract Nonr-562(27))
(AD-647739) CFSTI: HC$3.00/MF$0.65

The development of dislocation networks in gallium crystals, initially free of detectable dislocations, was studied at room temperature by an x-ray diffraction topographic technique. The condition required for the development of these networks is the existence of spatial periodic fluctuations in impurity content. The networks develop, in the absence of an external stress, from individual loops which are first detected 3 to 10 days after the crystal has been grown. These loops grow for days at a uniform rate of 10 to the minus 8th power cm/sec and reach a size of a few hundred microns. No specific nucleation mechanism for these loops has been identified. If it is assumed that the loops expand by climb (by the addition of vacancies), their rate of growth and observed densities are consistent with a formation energy for vacancies U sub f in the range 0.2 to 0.3 ev and a migration energy for vacancies U sub m in the range 0.4 to 0.7 ev. No values of U sub f, U sub m or U sub f + U sub m determined from other experiments have been reported and a comparison is not possible at the present time. The change of initially straight dislocation lines into jagged lines has been observed and is interpreted as the climb of screw dislocations into irregular helical dislocations. A marked anisotropy in the growth of the loops and helices was observed and is attributed to an anisotropic coefficient of self-diffusion. Author (TAB)

N67-24478*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THERMODYNAMIC PROPERTIES OF LIQUID METAL SOLUTIONS IN THE SODIUM–MERCURY SYSTEM AT 200°C
Albert C. Antoine Washington, NASA, May 1967 13 p refs
(NASA-TN-D-3951) CFSTI: HC$3.00/MF$0.65 CSCL 07D

Measurements were made of the electromotive force of sodium–sodium amalgam cells. The amalgam composition ranged from 0.01 to 0.15 atomic fraction of sodium. Values were obtained at 150°, 200°, and 250°C. The activity of sodium in the amalgam a_{Na} was obtained from the relation $nF\epsilon = -RT \ln a_{Na}$, where n is the number of electrons in the stoichiometric relation, F is a constant (Faraday), 23,066 calories per volt, ϵ is the electromotive force in volts, R is the gas constant in calories per degree, and T is the temperature in °K. Partial free energy, partial entropy, and partial heat of mixing of sodium in sodium amalgam were

calculated. The partial excess free energy of sodium and excess entropy were also obtained. The thermodynamic data for the other solution component, mercury, were also obtained. Integral values were obtained by graphical integration or by calculation from the partial values. The activity of sodium exhibited large negative deviations from ideality, while the activity of mercury followed closely Raoult's law in dilute sodium solutions. The formation of sodium–mercury alloys was accompanied by an exothermic heat effect. The free energies of mixing were large, while the entropy terms were small. Author

N67-24562# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
NONAQUEOUS ELECTROPOLISHING BATH FOR URANIUM
E. L. Childs and F. E. Evans Dec. 1966 8 p refs
(Contract AT(29-1)-1106)
(RFP-816) CFSTI: HC $3.00/MF $0.65

A nonaqueous bath for electropolishing U that consists of NaH_2PO_2 in 1,2-ethanediol is described. Studies were made of the effects of water content, pH, temperature, and salt concentration on the electropolishing procedure. Surface roughness using this method is reduced to about 60 percent of the original value. Author (NSA)

N67-24561# Union Carbide Nuclear Co., Oak Ridge, Tenn.
A METHOD OF USING A POROUS MEDIUM TO DETERMINE THE COEFFICIENTS OF VISCOSITY FOR BROMINE TRIFLUORIDE
T. W. Selby 13 Jan. 1967 35 p refs
(Contract W-7405-ENG-26)
(K-1680) CFSTI: HC $3.00/MF $0.65

Experimental evaluations have been made of a porous-medium method for determining relative coefficients of viscosity for corrosive and noncorrosive gases. The apparatus and operating procedure are described in detail. Measurements of the coefficients of viscosity for argon were made over the temperature range of 35° to 200°C and are given by the equation, η, micropoise $= 22.14\sqrt{T,°K} - 157.9$. Measurements of the coefficients of viscosity for bromine trifluoride were made over the temperature range of 130° to 200°C and are given by the equation, η, micropoise $= 21.33\sqrt{T,°K} - 230.2$. From these data, the force constants for the Lennard–Jones (6–12) potential for bromine trifluoride were calculated to be, $\epsilon/k = 595$K and $\sigma = 4.04$ A. Author (NSA)

N67-24562# Battelle-Northwest, Richland, Wash.
ION-EXCHANGE SEPARATION OF KILOCURIE QUANTITIES OF HIGH PURITY PROMETHIUM
E. J. Wheelwright, F. P. Roberts, U. L. Upson, L. J. Kirby, T. R. Myers et al Dec. 1966 18 p refs
(Contract AT (45-1)-1830)
(BNWL-318) CFSTI: HC $3.00/MF $0.65

Optimum conditions for the purification of the individual light rare earth elements by ion exchange elution were determined for the eluting agents EDTA, HEDTA, and DTPA. The conditions apply directly to the isolation of macro-quantities of pure promethium from the fission product rare earths. DTPA was demonstrated to be superior to both EDTA and HEDTA. Operating conditions are described that allow a 4-fold reduction of both the elution time cycle and the volume of waste solution generated compared to previously reported work. Seven 9-ft-high, water-thermostated ion exchange columns, ranging from 8 to 1 in. ID, plus associated tanks, pumps, and instrumentation, were installed in one of Battelle-Northwest Laboratory's hot cells. The technology developed during the isolation of 1,000,000 Ci of ^{147}Pm in this equipment is summarized. Author (NSA)

N67-24571# Los Alamos Scientific Lab., N. Mex.
FREEZING POINTS OF SOME TERNARY MIXTURES DERIVED FROM 55 MOLE % UCl_3–45 MOLE % KCl
B. J. Thamer 29 Nov. 1966 26 p refs
(Contract W-7405-ENG-36)
(LA-3579-MS) CFSTI: HC $3.00/MF $0.65

Differential thermal analysis was used to locate high-uranium, low-freezing compositions in some ternary fused salts containing UCl_3 and KCl. Evidence is presented for the following ternary eutectics (mole %): 5.0 UF_3–50.8 UCl_3–44.2 KCl, 518°C; 5.0 UF_4–48.5 UCl_3–46.5 KCl, 499°C; 46 LiCl–30 UCl_3–24 KCl, 418°C; 35 NaCl–35 UCl_3–30 KCl, 510°C; and 27 $MgCl_2$–25 UCl_3–48 KCl, 447°C. The applicability of these mixtures to a molten blanket for a fast reactor is discussed. Author (NSA)

N67-24575# Los Alamos Scientific Lab., N. Mex.
EQUILIBRIUM ANION EXCHANGE OF URANIUM(VI) ON DOWEX 1X4 FROM NITRIC ACID SOLUTIONS
D. B. James 20 Dec. 1966 16 p refs
(Contract W-7405-ENG-36)
(LA-3540) CFSTI: HC $3.00/MF $0.65

Equilibrium exchange isotherms for uranium(VI) sorbed on Dowex 1X4 anion exchange resin from nitric acid solutions were determined for 5, 7, and 8.3M nitric acid at 24°C and for 7M nitric acid at 40 and 60°C. The results were numerically fitted by a least-squares technique to mass-action theory, assuming sorption as $UO_2(NO_3)_3^-$ and $UO_2(NO_3)_4^{--}$ Author (NSA)

N67-24577# California Univ., Berkeley. Lawrence Radiation Lab.
A CONVENIENT TABULATION OF THE DEBYE ENERGY, HEAT CAPACITY, FREE ENERGY AND ENTROPY FOR A CRYSTALLINE SOLID
Walter A. Stark and R. N. Kortzeborn Oct. 1966 47 p refs
(Contract W-7405-ENG-48)
(UCRL-17225) CFSTI: HC $3.00/MF $0.65

The Debye integrals for the heat capacity, energy, free energy and entropy were evaluated using a very fast and accurate numerical integration routine. The results are given as a function of T/θ_D, where T is absolute temperature and θ_D is the characteristic Debye temperature, in increments of 0.001 from 0.001 to 2.000 and in increments of 0.1 from 2.100 to 12.000. Author (NSA)

N67-24580*# Dow Chemical Co., Midland, Mich. Thermal Research Lab.
JANAF THERMOCHEMICAL TABLES, FIRST ADDENDUM
J. Chao, A. T. Hu, G. C. Karris, E. W. Phillips, H. Prophet et al Aug. 1966 211 p refs
(Contract AF 04(611)-7554(4); AF 04(611)-11201)
(NASA-CR-83718; PB-168-370-1) CFSTI: HC $3.00/MF $0.65
CSCL 07D

Thermochemical constants are tabulated for compounds and elements over the temperature range 0°–6000°K. Also included are data such as heat of formation and heat capacity, electronic levels and quantum weight, and ground state configuration. N.E.N.

N67-24596# European Atomic Energy Community, Ispra (Italy).
THE THERMAL RELEASE OF KRYPTON FROM THIN LAYERS OF UO_2
O. Gautsch, C. Mustacchi, A. Schurenkamper, and H. Wahl Brussels, EURATOM, Jan. 1967 21 p refs
(EUR-3267.4) CFSTI: HC $3.00/MF $0.65

One type of experiments consisted in annealing sintered UO_2 pellets which were previously bombarded with Kr ions of a few keV. In a second type of experiments layers of recondensed UO_2 containing between 0.04 and 0.1 Kr atoms per atom of U, were annealed. Author

N67-24657# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
APPLICATION OF ELECTRON PARAMAGNETIC RESONANCE IN CHEMISTRY

L. A. Blyumenfel'd, V. V. Voyevodskiy, and A. G. Semenov 6 Dec. 1966 403 p refs Transl. into ENGLISH of the book "Primeneniye Elektronnogo Paramagnitnogo Rezonansa V Khimii" Novosibirsk, Izd. Sibirsk. Otd. An SSSR, 1962 p 1–240
(FTD-MT-64-306; TT-67-60997; AD-646962) CFSTI: HC $3.00/MF $0.65

The report contains applications of paramagnetic resonance in chemistry. The criteria for the successful use of electron paramagnetic resonance are listed. The first part, Chapters I–IV, considers questions connected with the experimental technology theory of the method and treatment of experimental data. The second part, Chapters VII–XII concerns the use of electron paramagnetic resonance to solve a number of contemporary chemistry problems. Chapter I gives general information about the method, its theoretical basis and EPR spectrometers. Chapter II deals more specifically with spectrometers, particularly the EPR-2 Type. Chapter III expounds the EPR method's contemporary theory, in which theoretical problems are discussed. Chapters IV, V, and VI give methods of the primary treatment of spectra and the extraction of chemical information from them. Part Two considers new prospects in chemistry as a result of the EPR methods. New ways of investigating intermediate substances and elementary acts possible after discovering the EPR are cited. Author (TAB)

N67-24672# Allis-Chalmers Mfg. Co., Milwaukee, Wis.
DESIGN STUDY OF HYDROGEN PRODUCTION BY ELECTROLYSIS, VOLUME II Final Technical Report, Mar. 1–Jun. 30, 1966
Oct. 1966 171 p Prepared for Oak Ridge Natl. Lab.
(Contract W-7405-ENG-26)
(ACSDS-0106643, Vol. II; TID-23439, Vol. II) CFSTI: HC $3.00/MF $0.65

Drawings, preliminary specifications, and cost estimates for the electrolytic production of hydrogen are presented. NSA

N67-24674# Allis-Chalmers Mfg. Co., Milwaukee, Wis.
DESIGN STUDY OF HYDROGEN PRODUCTION BY ELECTROLYSIS, VOLUME I Final Technical Report, Mar. 1–Jun. 30, 1966
Oct. 1966 54 p Prepared for Oak Ridge Natl. Lab.
(Contract W-7405-ENG-26)
(ACSDS-0106643, Vol. I; TID-23439, Vol. I) CFSTI: HC $3.00/MF $0.65

The design study of hydrogen production by electrolysis, was centered around low capital investment as the primary goal, with other factors, such as high efficiency, long life, simple, trouble-free operation, maintenance and down time also influencing the conceptual system. Only uncatalyzed porous nickel electrodes were considered. Two electrolysis plant sizes were considered during the conceptual phase of the study: 4,400 pounds of hydrogen per hour (equivalent to 300 tons of ammonia per day) and 44,000 pounds of hydrogen per hour (equivalent to 3,000 tons of ammonia per day). The hydrogen is to be delivered at 3,000 psig directly to an ammonia plant. Preliminary estimates made early in the program comparing low pressure (300 psig) and high pressure (3,000 psig) electrolysis plants indicated that high-pressure system capital costs would be economically unattractive; all subsequent systems studied were at 300 psig. Three hydrogen plants were studied in this program and cost estimates were prepared for their total installation and operation. The plants were evaluated as to their subsystems and the costs for all their components. NSA

N67-24681# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.
THE URANIUM DIOXIDE–URANIUM SYSTEM AT HIGH TEMPERATURE [LE SYSTEME URANIUM-DIOXYDE D'URANIUM A HAUTE TEMPERATURE]
Philippe Guinet, Henri Vaugoyeau, and Pierre Blum 1966 20 p refs In FRENCH
(CEA-R-3060) CFSTI: HC $3.00/MF $0.65

The liquidus curve was determined by a saturation method in which the thermal gradient was cancelled upon cooling, and the solidus curve by analyzing the deposits in equilibrium with the liquid at each temperature. The diagram, of a displaced eutectic type, presents a liquid immiscibility domain between 47 and 59 mole % of dioxide and a substoichiometry range UO_{2-x}; the minimum O/U ratio was 1.6 at 2470±30°C. The monotectic composition was found by chemical analysis to be 59 mole % of dioxide and the reaction temperature 2470±30°C. Author (NSA)

N67-24718# Coating and Chemical Lab., Aberdeen Proving Ground, Md.
IDENTIFICATION AND CHARACTERIZATION OF PETROLEUM FUELS USING TEMPERATURE-PROGRAMMED GAS–LIQUID CHROMATOGRAPHY Final Report
Maurice E. LePera Nov. 1966 45 p refs
(CCL-218; AD-646382) CFSTI: HC $3.00/MF $0.65

A technique was developed for the identification and preliminary characterization of petroleum fuels utilizing temperature-programmed gas-liquid chromatography. A listing of prepared chromatograms, comprising from gasoline to diesel fuels, are provided as reference standards for profile evaluations. Unknown fuels can be identified as to either gasoline, turbine, or diesel and characterization according to specific grade (or type) or composition (aromatic or paraffinic) can be determined. Author (TAB)

N67-24726# Coating and Chemical Lab., Aberdeen Proving Ground, Md.
SEPARATION AND IDENTIFICATION OF ANHYDRIDE-TYPE EPOXY CURING AGENTS AS THEIR TRIMETHYLSILYL DERIVATIVES BY GAS CHROMATOGRAPHY Interim Report
George G. Esposito Jan. 1967 12 p ref
(CCL-223; AD-647161) CFSTI: HC $3.00/MF $0.65

Liquid and solid anhydrides have found extensive use as curing agents for epoxy resins. A method is described for the derivitization of anhydrides and their subsequent analysis by gas–liquid chromatography (GLC). The procedure is rapid and specific for most of the curing agents examined. The anhydride is refluxed with hexamethyldisilane and the volatile derivatives are separated by GLC on a 1 ft. silicone grease column. Author (TAB)

N67-24736# Naval Research Lab., Washington, D. C.
THE PERMEABILITY AND ELUTRIATION METHODS FOR DETERMINING THE SPECIFIC SURFACE OF DRY CHEMICAL FIRE-EXTINGUISHING POWDERS Final Report
H. E. Moran, Jr. 20 Jan. 1967 31 p refs
(NRL-6499; AD-647151) CFSTI: HC $3.00/MF $0.65

The air permeability (Blaine) method gives a direct measure of the total surface of a powder sample. The air elutriation (Roller) method gives the distribution of particle diameters in a sample, from which the surface can be found by numerical or graphical integration. Measurements of the specific surface by the permeability method of powders ranging from approximately 2600 to 5900 sq. cm. g. were reproducible to within plus or minor 1.5% when the test was carried out in a preferred manner. The air elutriation method proved to be very sensitive to the relative humidity of the operating air when used with the same powder as used in the permeability method. In some instances, separating with dry air gave values of specific surface nearly double those obtained using moist air. In view of this sensitivity to operating conditions, as well as the much greater time required for each determination, the elutriation method appeared to be unsuitable for characterizing dry chemical powder extinguishants. Author (TAB)

N67-24738# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SYNTHESIS ON THE BASIS OF ORGANIC DERIVATIVES OF MERCURY
V. A. Nefedov and M. N. Nefedova 29 Aug. 1966 13 p refs Transl. into ENGLISH from Zh. Obshch. Khim. (Moscow), v. 36, no. 1, 1966 p 122–126
(FTD-HT-66-478; TT-67-60769; AD-646374) CFSTI: HC $3.00/MF $0.65

By the exchange of a mercury group for an anion of copper salt from mercurized ferrocenes there were obtained halide-, rhodano-, acetoxy-, and phthalimindo-ferrocenes. The substitution of halide in bromoferrocenes for the phenoxy group was accomplished. A number of sulfur derivatives of ferrocene were obtained. Author (TAB)

N67-24747# Naval Research Lab., Washington, D. C.
SPREADING PRESSURE, INTERFACIAL TENSION, AND ADHESIONAL ENERGY OF THE LOWER ALKANES, ALKENES, AND ALKYL BENZENES ON WATER
Philip Pomerantz (Bureau of Naval Weapons), W. C. Clinton, and W. A. Zisman 19 Jan. 1967 30 p refs Presented at the Div. of Colloid and Surface Chem. at the 152d Ann. Meeting of the Am. Chem. Soc., New York, 12 Sep. 1966
(NRL-6495; AD-646995) CFSTI: HC $3.00/MF $0.65

An investigation was made on the effect of molecular structure and unsaturation upon the initial spreading pressure (F sub ba) on water of numerous representative low-boiling hydrocarbons of exceptional purity. These compounds included members of the paraffin, olefin, aromatic, and acetylene families. Measurements of F sub ba were made at 20C using the 'piston monolayer' method. In agreement with the results of Washburn et al., F sub ba was always equal (or nearly so) to the initial spreading coefficient (S sub ba). The relations between the initial, semi-initial, final, and equilibrium spreading pressures and the corresponding spreading coefficients are discussed. The conditions under which the initial spreading pressure (F sub ba) is equal to the Harkins initial spreading coefficient (S sub ba) is established thermodynamically. It is shown that the value of S sub ba and the initial value of gamma sub ab, the interfacial tension against water, and W sub ba, the initial value of the reversible work of adhesion, can be calculated from F sub ba, the surface tension of the organic liquid (gamma sub b), and the surface tension of water (gamma sub a). Additional data on the hydrophilic nature of olefinic, aromatic, and acetylenic bonds are presented and discussed in terms of the molar work of adhesion. Author (TAB)

N67-24755# Texas Univ., Austin. Dept. of Chemistry.
THE REACTION OF MOLECULES IN EXCITED ELECTRONIC STATES WITH PARAMAGNETIC GASES Final Report
W. Albert Noyes, Jr. [1966] 8 p refs
(Grant AF-AFOSR-778-65)
(AFOSR-67-0280; AD-646673) CFSTI: HC $3.00/MF $0.65

Work in the following areas is briefly summarized: identification of singlet and triplet states of perfluorobenzene, fluorobenzene, and perfluorocyclobutanone; photochemical isomerization of substituted cycloheptatrienes; electronic energy relaxation via isomerization in toluene; photolysis of cyclobutanes. Portions of these studies are reported in greater detail in AD-617 988 and AD-635 437. TAB

N67-24760# Cornell Univ., Ithaca, N. Y. Dept. of Chemistry
FLUORINE FREE RADICAL CHEMISTRY Final Report, Sep. 1961–Jan. 1966
James O. Stoffer, Manfred Unger, and Hanns-Helge Stechel Jan. 1966 12 p
(Contract DA-31-124-ARO-(D)-26)
(AD-647471) CFSTI: HC $3.00/MF $0.65

The general objective of the work carried out has been to provide an increased understanding of the reactions which take place when organic compounds are brought into contact with elemental fluorine and to develop suitable methods for utilizing such reactions for the synthesis of highly fluorinated compounds. Free radical intermediates are characteristically produced by reaction of fluorine with organic compounds and the use of fluorine both as a fluorinating reagent and as a free-radical initiator was of interest. Author (TAB)

N67-24763# Colorado State Univ., Fort Collins.
PRELIMINARY INVESTIGATION OF A NEW GENERATOR FOR SILVER IODIDE USING ISOPROPYLAMINE AS THE CARRIER
Roger L. Steele [1966] 10 p refs *Its* Mech. Eng. Tech. Paper-66.2 and Atmospheric Sci. Tech. Paper-76
(Grants NSF GP-1663; NSF GA-311)
(PB-170-488) CFSTI: HC $3.00/MF $0.65

A new system for producing silver iodide ice nuclei is described. Isopropylamine, instead of ammonia, is employed as the carrier. Silver iodide complexes readily with the amine and has the following advantages: (a) high concentrations may be used without corrosion or deposition, (b) solution preparation is simple and direct, (c) straight isopropylamine may be used to purge the system after use, and (d) no support fuel is needed. The system produces high effectiveness over the temperature spectrum, e.g., 1.5×10^{15} and 8×10^{13} nuclei per gram at $-20°$ and $-10°C$ respectively. Disadvantages are: (a) dispersion cost may be 12% higher than with acetone and (b) the amine is more toxic than acetone. However with minor precautions, the complex is easily stored and handled at ambient pressure temperature. Carbon steel or aluminum are used for containment. The simple, reliable storage and thermal processing system is described in detail. This is composed of a storage tank, connecting piping, hydraulic nozzle and combustion chamber which is supplied with air by means of an inexpensive blower. Author

N67-24781# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF THE COMPOSITION OF ORGANOSULFUR COMPOUNDS OF KEROSINE–GASOLINE FRACTIONS OF PETROLEUM [ISSLEDOVANIYE SOSTAVA SERAORGANICHESKIKH SOYEDINENIY KEROSINOGAZOLYEVYKH FRAKTSIY NEFTI]
G. F. Bol'shakov and Ye. A. Glebovskaya 23 Jan. 1967 24 p refs Transl. into ENGLISH from Khim. Seraorganicheskikh Soedinenii, Sode Rzhashchikhsya V Neftyakh I Nefteproduktakh (USSR), v. 6, 1964 p 53–65
(FTD-MT-65-282; TT-67-61128; AD-647733) CFSTI: HC $3.00/MF $0.65

Organosulfur compounds included in the composition of the resinous part of the fuels TS-1, DA, and T-1 are represented, basically, by sulfides, derivatives of thiophane, and complicated heteroorganic compounds. Small quantities of mercaptans and disulfides were found. The composition of residual sulfur includes chiefly derivatives of thiophane and thiophene, with impurities of certain sulfur- and nitrogen-containing compounds. Organosulfur compounds extracted from the aromatic fraction of fuel TS-1 consist, basically, of aliphatic sulfides, alkylsubstituted thiophanes, and thiophenes. Organosulfur compounds separated from the aromatic fraction of fuel DA are represented basically by sulfides, thiophanes, thiophenes of various structures, and (in small quantity) disulfides. Impurities of mercaptans and sulfoxides are not excluded. The use of the method of infrared spectroscopy in the longwave region

holds promise in the investigation of the group of organosulfur compounds which are not determined by chemical methods.
Author (TAB)

N67-24790# Carnegie Inst. of Tech., Pittsburgh, Pa. Dept. of Physics.
A MOESSBAUER EFFECT STUDY OF ELECTRONIC RELAXATION IN THE PARAMAGNETIC COMPOUND: $NH_4(Fe,Al)(SO_4)_2 \cdot 12H_2O$
Larry E. Campbell (Ph.D. Thesis) Sep. 1966 123 p refs
(Contract Nonr-760(20))
(TR-6; AD-646626) CFSTI: HC $3.00/MF $0.65

The Mossbauer spectra of paramagnetic ferric compounds exhibit magnetic hyperfine splittings when the electronic relaxation rates of the ferric ions are made comparable to the precession frequency of the nucleus in the hyperfine field. This was observed in ferric ammonium alum diluted in aluminum ammonium alum NH4(Fe,Al)(SO4)2.12H2O), as a function of iron concentration, temperature, deuteration and external magnetic field. The effect was also observed in the corresponding potassium alums. The crystalline field levels of the ferric ion consists of three Kramers doublets and each doublet produces its own hyperfine pattern. In the absence of an external magnetic field, the spectrum due to the Sz = plus or minus 5/2 doublet was completely resolved, that due to the plus or minus 3/2 doublet partially resolved and that due to the plus or minus 1/2 doublet not resolved at all. Relaxation time estimates are made ranging from 4 x 10 to the -7th power sec to 6 x 10 to the -11th power sec depending on the concentration, the temperatures and the particular Kramers doublet under consideration. The magnetic field produced at the nucleus by the plus or minus 5/2 doublet was found to be -572 plus or minus 7 kgauss. The isomer shift is 0.53 plus or minus 0.1 mm/sec and the quadrupole interaction energy 1/4(E Sq)qQ=0.055 plus or minus 0.025 mm/sec.
Author (TAB)

N67-24816# Maryland Univ., College Park. Dept. of Chemistry.
A PHOSPHORUS-31 NMR STUDY OF TERTIARY PHOSPHINE COMPLEXES OF PLATINUM Final Report, 1 Nov. 1964–31 Oct. 1966
Samuel O. Grim, Richard L. Keiter, and William McFarlane Jan. 1967 43 p refs
(Grant AF-AFOSR-782-65)
(AFOSR-67-0417; AD-647265) CFSTI: HC $3.00/MF $0.65

The phosphorus-31 nmr spectra of eleven cis and seven trans compounds of the type (R sub n Ph sub 3-n P)2PtCl2, where R = alkyl and n = 1,2, or 3, show that the platinum-195 to phosphorus-31 coupling constant is always larger for the cis compound than for the corresponding trans compound and that the phosphorus chemical shift of the cis compound is upfield from that of the corresponding trans compound. The formation of the tris-phosphine complex by addition of excess tertiary phosphine to the monomer has been demonstrated by conductivity and 31p nmr measurements and confirmed by isolation of the compounds. (MePh2P)3PtCl)Cl and (PrPh2P)3 - PtCl)BPh4. The preparation of several new chlorine bridged dimers is also reported. The phosphorus-31 chemical shifts are reported for twenty-five compounds of the type (RnPh sub 3-nP)M(CO)5, where R is alkyl, n is 0,1,2,3 and M is Cr, Mo, or W. The 183W-31P spin-spin coupling is observed for all the tungsten compounds and a linear correlation exists between these coupling constants and the carbonyl stretching frequencies in the respective compounds.
Author (TAB)

N67-24823# Naval Research Lab., Washington, D. C.
CRITICAL SURFACE TENSION FOR SPREADING ON A LIQUID SUBSTRATE
Elaine G. Shafrin and W. A. Zisman 17 Jan. 1967 20 p refs
(NRL-6488; AD-646869) CFSTI: HC $3.00/MF $0.65

A plot of the initial spreading pressures (F sub ba) or initial spreading coefficients (S sub ba) against the surface tensions of a homologous series of organic liquids b can be used to determine the critical surface tension for spreading on a second substrate liquid phase a. Straight-line relations are found for various homologous series. The intercept of that line with the axis of abscissas (F sub ba = 0, or S sub ba = 0) defines a value of spreading for that series. This method is advantageous because it eliminates the need for measuring (or calculating) the contact angle of lens b floating on liquid a. it can be applied to any liquid substrate, and it is applicable even when spreading does not lie within the range of surface tensions of the members of the homologous series of liquids b. The value of spreading for the water/air interface was determined in this way using several homologous series of pure hydrocarbon liquids. The lowest value found was 21.7 dynes/cm at 20C for the n-alkane series. Higher spreading values were obtained using olefins or aromatic hydrocarbons as the result of interaction between the unsaturated bond and the water surface. Since the results are analogous to those reported earlier for solid surfaces, it is concluded that the clean surface of water behaves as a low-energy surface with respect to low-polarity liquids. This result is to be expected if only dispersion forces are operative between each alkane liquid and water.
Author (TAB)

N67-24828# California Univ., Los Angeles. Dept. of Chemistry.
THE VAPOR PRESSURE OF TETRAFLUOROMETHANE FROM 86–146°K
M. Simon, C. M. Knobler, and A. G. Duncan 30 Dec. 1966 14 p refs Submitted for publication
(Contract Nonr-4756(05))
(TR-2; AD-646757) CFSTI: HC $3.00/MF $0.65

The vapor pressure of CF, has been measured from 86-146K. The equation log p(torr) = 8.5019 - 769.89/T represents the data for the solid. Above the triple point, 89.55K, the vapor pressure is represented by the equation, log p(torr) = 6.836841 - 511.69474/(T - 15.7744). The heat of vaporization calculated by the Clapeyron equation from the data ranges from 3.4 to 2.8 kcal/mole from the triple point to the normal boiling point, 145.12K.
Author (TAB)

N67-24840# Boston Coll., Chestnut Hill, Mass.
HIGH PRESSURE AND DIELECTRIC INVESTIGATIONS OF THE ALKALINE EARTH FLUORIDES Final Report, Oct. 1964–Jun. 1966
Joseph H. Chen and Henry I. Smith Aug. 1966 186 p refs
(Contract AF 19(628)-4041)
(BC-P-201; AFCRL-66-601; AD-646654) CFSTI: HC $3.00/MF $0.65

The interactions between ions in the alkaline earth fluorides were investigated by means of two independent studies: (1) direct evaluation of the repulsive interaction, and (2) dielectric relaxation measurements on doped samples. With respect to (1), the experimental approach was to apply pressure up to about 65 kilobars directly to samples of CaF2, SrF2, and BaF2 using a tetrahedral-anvil press. The change of lattice spacing with pressure was determined by X-ray diffraction. These data were then analyzed in terms of the Mie-Gruneisen equation of state to obtain the dependence of the repulsive lattice energy on interionic separation. From this, the magnitude and functional dependence of the repulsive interaction between ions was inferred using the theoretical formalism of the Born model. In the dielectric measurements, loss peaks were observed in samarium and uranium doped calcium fluoride crystals. The measurements covered a range from 1Hz to 300KHz and from 100C to 500C. The relaxation mechanism could be attributed to the rotation of dipoles made up to X393+) impurity ion at a Ca(2+) site and a charge compensator F(-) at the nearest interstitial site. Activation energy obtained increased with increasing impurity ion size.
Author (TAB)

N67-24863# Lund Univ. (Sweden). Thermochemistry Lab.
QUANTITATIVE ASPECTS ON THERMAL STABILITY OF ORGANIC COMPOUNDS Final Report
S. Sunner 11 Nov. 1966 27 p refs
(Grant AF-EOAR-64-34)
(AFOSR-67-0523; AD-647707) CFSTI: HC $3.00/MF $0.65

The thermal decomposition of 2-methyl-2-propanol was studied at 153C with a semi-automatic pyrolysis apparatus. The initial rate constants at various pressures of the butanol (20 to 0.15 mm Hg) usually mixed with argon, in some experiments with oxygen, were measured. The change of the reaction order depending on the reactant pressure was observed. The equilibrium constant for the reaction: (CH3)3COH reversibly yields (CH3)2C:CH2 + H2O was determined and the free energy change at 153C calculated to be -3.21 plus or minus 0.04 kcal/mole. Author (TAB)

N67-24871# Illinois Univ., Urbana. Dept. of Chemistry and Chemical Engineering.
CONFORMATIONAL ISOMERIZATION OF HEXAHYDRO-1, 3, 5-TRIMETHYL-1, 3, 5-TRIAZINE
H. S. Gutowsky and Piero A. Temussi 17 Jan. 1967 17 p refs Submitted for publication
(Contract Nonr-1834(13))
(TR-3; AD-646902) CFSTI: HC $3.00/MF $0.65

The H high-resolution spectrum of hexahydro-1,3,5-trimethyl-1,3,5-triazine was observed at temperatures from −58 to +42C. The rate of conformational isomerization was determined by a complete line-shape analysis method over the temperature range −26 to +42C. From these rates, the activation parameters were determined to be 15.2 plus or minus 0.2 and 13.2 plus or minus 0.2 kcal/mole and 7.5 eu, respectively, at the coalescence temperature of 268.1K. It is proposed that the mechanism of conformational isomerization involves inversion of the ring in synchronism with inversion of one or two of the nitrogen atoms, followed or proceeded by a fast inversion of the other nitrogens. s-trioxane and 2,4,6-hexamethyl-1,3,5-trithiane (HMTT) were studied also. The isomerization rate of s-trioxane proved to be too fast for measurement and that of HMTT too fast for a complete study. However, spin-echo measurements of the latter gave an approximate value of 8 kcal/mole for the free energy of activation. Author (TAB)

N67-24876# Monsanto Research Corp., Dayton, Ohio.
BASIC RESEARCH ON SYNTHESIS OF NEW PHOSPHORUS–NITROGEN REAGENTS Interim Report, 15 Nov. 1964–15 Nov. 1965
Morris L. Nielsen Wright-Patterson AFB, Ohio. ARL Jan. 1966 28 p refs
(Contract AF 33(615)-2218)
(ARL-66-0003; AD-646745) CFSTI: HC $3.00/MF $0.65

Two compounds of the general formula (RO)2P-ONHP-O(OR)2 were prepared and applied in the preparation of metal derivatives. Tetraethyl imidodiphosphate and tetraphenyl imidodiphosphate were prepared by published methods. New crystalline derivatives were obtained for the first compound with zinc, for the second compound with zinc, palladium, lanthanum, cerium, praseodymium and europium. A tetramminepalladium (II) derivative of tetraphenyl imidodiphosphate is promising for the gravimetric determination of palladium. Author (TAB)

N67-24898# Harvard Univ., Cambridge, Mass. Dept. of Chemistry.
THE MICROWAVE SPECTRUM, STRUCTURE, DIPOLE MOMENT AND QUADRUPOLE COUPLING CONSTANT OF GERMYL CYANIDE
Ravi Varma and Keith S. Buckton 30 Jun. 1966 16 p refs
(Contract Nonr-1866(14))
(AD-645778) CFSTI: HC $3.00/MF $0.65

The symmetric top spectra of ten isotopic species of GeH3CN were observed and measured. From the rotational constants obtained the following structural parameters were derived: r(C-N) = 1.55 plus or minus 0.001 A and r(Ge-C) = 1.919 plus or minus 0.001 A, assuming r(Ge-H) = 1.529 A and a tetrahedral distribution about the Ge atom. From an analysis of the splittings observed in the 1 to 2 transitions of GeH3CN a quadrupole coupling constant for the nitrogen nucleus of -5.0 plus or minus 0.1 Mc/s was obtained. Analysis of the Stark effect gives a dipole moment of 3.99 plus or minus 0.05 D. Author (TAB)

N67-24934# State Univ. of New York, Brooklyn.
CHEMICAL REACTIVITY AT DEFECT SITES IN SOLIDS
Joseph Jach Jan. 1967 31 p refs
(Contract Nonr-4673(00))
(TR-3; AD-647795) CFSTI: HC $3.00/MF $0.65

A study was made of the thermal decomposition of NaBrO3 which thermally decomposes according to the equation NaBrO3 yields NaBr+3/2 O2. TAB

N67-24936# Manchester Univ. (England). Inst. of Science and Technology.
INHIBITION OF THE THERMAL REACTION BETWEEN HYDROGEN AND OXYGEN Final Scientific Report
D. R. Clark and R. F. Simmons 1 Dec. 1966 20 p refs
(Grant AF-EOAR-65-15)
(AFOSR-67-0678; AD-647886) CFSTI: HC $3.00/MF $0.65

It was shown that the effect of hydrogen bromide on the second limit of the hydrogen-oxygen reaction in B2O3-coated reaction vessels can be explained in terms of the inhibition mechanism: H + HBr yields H2 + Br; Br + H2 yields HBr + H; Br + HO2 yields HBr + O2; Br + H2O2 yields HBr + HO2. A preliminary analysis of the experimental results suggests that k18 is approx. 1 x 100000/(mm Hg)/sec and k20 is approx. 1 x 10000/(mm Hg)/sec at 500C. A computer study of the surface destruction of chain centres was also made to establish whether the removal processes are independent of each other when two types of species are destroyed at the surface. It was found that these processes are almost independent of each other except when the efficiencies with which the two species are destroyed are vastly different. The application of these calculations to the first limit of the hydrogen-oxygen reaction is discussed. Author (TAB)

N67-24964# Brandeis Univ., Waltham, Mass. Dept. of Chemistry.
[TOPICS IN THEORETICAL CHEMISTRY] Final Report, Apr. 15, 1955–May 31, 1966
Sidney Golden 31 Dec. 1966 17 p refs
(Contract Nonr-1677(01))
(AD-647082) CFSTI: HC $3.00/MF $0.65

The results of research are summarized. Topics included are: (1) Statistical Theory of Electronic Energies, (2) Formal Theory of Chemical Kinetics, (3) Metal–Ammonia Solutions and (4) Ionic Solvation in Polar Solvents. Author (TAB)

N67-24969# Western Reserve Univ., Cleveland, Ohio. Electrochemistry Research Lab.
THE ELECTRICAL AND DISSOLUTION PROPERTIES OF NICKEL OXIDE
Alan Riga, Robert Greef, and Ernest Yeager 1 Dec. 1966 169 p refs
(Contract Nonr-1439(09))
(TR-2; AD-646456) CFSTI: HC $3.00/MF $0.65

The dissolution of lithiated single crystal nickel oxide was studied in HCl and H2SO4 as functions of potential, temperature, time, and lithium content with in situ photomicrographic examination of the dissolving surface. This research indicates that the dissolution rate is extremely low even at elevated temperatures in concentrated acids and increases very rapidly (by at least several fold) over a

narrow range of potentials as the potential is adjusted to more anodic values. The potential region of rapid transition corresponds to a prominent peak in the linear sweep voltammetry curves as well as in the a.c. capacity versus potential curves and correlates with the potential assigned by Pourbaix to the Ni(II)/Ni(III) couple for the nickel oxide-water system. In HCl the dissolution increases much more slowly with increasing adodic potential. Some evidence exists that the logarithm of the dissolution rate is linearly dependent on potential and has the same slope both below and above the rapid transition region. The steady state surface topography at potentials anodic to the rapid transition region is characterized by well formed etch pits, while at more cathodic potentials, no etch pits are evident even after prolonged dissolution. The dissolution kinetics are interpretated in terms of a quantitative model according to which the rate-determining step is the transfer of nickel ions over a potential energy barrier from the oxide to the Helmholtz plane in the solution phase. Author (TAB)

N67-24970# Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy.

A THERMODYNAMIC INVESTIGATION OF THE COMPOUNDS In_3SbTe_2, InSb AND InTe

A. K. Jena, M. B. Bever, and M. D. Banus 23 Jan. 1967 23 p refs Submitted for publication

(Contract Nonr-3963(19))

(TR-2; AD-647083) CFSTI: HC$3.00/MF$0.65

The heats of formation at 78, 195, and 273°K of the ternary compound In3SbTe2 based on the elements and based on the binary compounds InSb and InTe were measured. The heats of formation at these temperatures of the binary compounds InSb and InTe based on the elements were also determined. Heat contents and free energies of the three compounds were calculated from 0 to 800°K. The free energies of formation, heats of formation and entropies of formation at 298°K were calculated. The results show that the ternary compound is metastable with respect to InSb and InTe below 696°K, but is stable above that temperature. The weaker bonding of In3SbTe2 results in a positive entropy of formation which with increasing temperature makes increasing negative contributions to the free energy and above 696°K renders the compound stable. Author (TAB)

N67-24979# Royal Inst. of Tech., Stockholm (Sweden). Physics Dept.

CONSECUTIVE ION-MOLECULE REACTIONS IN METHANE INVESTIGATED BY MEANS OF POSITIVE ION-IMPACT

I. Szabo 15 Nov. 1966 24 p refs

(Contract AF 61(052)-762)

(SR-8; AFCRL-67-0059; AD-647491) CFSTI: HC $3.00/MF $0.65

The ion-molecule reactions in methane (CH4) were studied in detail up to third order processes in the pressure range 0.00008 - 0.001 mm Hg. From the pressure dependence of the ion currents, the mechanism of the formation of the product ions can be determined as a function of the energy absorbed by the molecule during the charge exchange. The ion-molecule reactions are discussed. Between 15.5 eV and about 20 eV the fragment ion CH2(+) is formed in the ground state, but above 20 eV the main part of the CH2(+) ions is probably in an excited state that can cause ion-molecule reactions of different type. Author (TAB)

N67-24983# Space-General Corp., Los Angeles, Calif. Center for Research and Education.

A BORON-PERMETHYL CLOSO-CARBORANE: $H_2C_2B_5(CH_3)_5$

V. Seklemian and Robert E. Williams 17 Jan. 1967 9 p refs Submitted for publication

(Contract Nonr-4381(00))

(TR-11; AD-646576) CFSTI: HC$3.00/MF$0.65

A report is given of the synthesis of the first boron-permethyl closo-carborane, H2C2B5(CH3)5, a derivative of closo-2,4-dicarbaheptaborane in which all of the borons—and only the borons—are methylated. This compound was prepared by co-pyrolysis of nido-2,3-dicarbahexaborane and boron trimethyl at 300C. Interest in this and related compounds stems from their potential uses as precursors of thermally stable polymers. TAB

N67-24984# Pennsylvania State Univ., University Park. Materials Research Lab.

MATERIALS PREPARATION AND CHARACTERIZATION RESEARCH Technical Summary Report, 1 Jul.–31 Dec. 1966

Rustum Roy 31 Dec. 1966 39 p refs

(Contract DA-49-083-OSA-3140; ARPA Order 338)

(AD-647065) CFSTI: HC$3.00/MF$0.65

Contents: Research results—Material preparation; growth of large crystals; new techniques. Research results—Materials characterization; application of the electron microprobe to the characterization of solids; new techniques for the study of X-ray absorption fine structure; construction and testing of vacuum curved crystal spectrometers; characterization of gel-grown crystals; surface studies of NaF and CaF2 in various ambient atmospheres, use of a laser ultramicroscope for detection of imperfections in solids; characterization by X-ray methods; structure analysis and crystal physics. TAB

N67-24988# Naval Research Lab., Washington, D. C.

USE OF THIN-LAYER CHROMATOGRAPHY (TLC) FOR IDENTIFICATION OF AIRCRAFT ENGINE OIL COMPONENTS

L. Green and H. Ravner 9 Nov. 1966 16 p refs

(NRL-6465; AD-646699) CFSTI: HC$3.00/MF$0.65

Thin-layer chromatography (TLC) using a silica gel adsorbent on a plastic backing, and n-heptane-acetone (95:5) developing solvent, permits useful separation of (a) esters derived from pentaerythritol, dipentaerythritol, and dibasic acids, (b) silicones, and (c) petroleum-based fluids. Esterification mixtures of both pentaerythritol and dipentaerythritol could not be resolved into their respective homologs. With benzene developing solvent, the caproate and valerate of pentaerythritol could be separated; in other respects, the solvent was less satisfactory than n-heptane-acetone because of its tendency to cause streaked chromatograms. Dibasic acid and trimethylolpropane esters could not be differentiated except by saponification and resolution of the liberated acids with benzene-acetone solvent (85:15). TLC shows some promise for rapid, specific separations, e.g., esters and silicones from petroleum-based oils and hydraulic fluids. Even with additional refinements of the method, however, results as precise or complete as those obtained with gas-liquid chromatography (GLC) or nuclear magnetic resonance (NMR) appear improbable. Author (TAB)

N67-25021*# National Aeronautics and Space Administration, Washington, D. C.

NATURAL VIBRATIONS AS CAUSE OF ENERGY FLUCTUATIONS AND CHEMICAL CONVERSIONS [UEBER DIE INTERFERENZ VON EIGENSCHWINGUNGEN ALS URSACHE VON ENERGIESCHWANKUNGEN UND CHEMISCHER UMSETZUNGEN]

M. Polanyi and E. Wigner Mar. 1967 15 p refs Transl. into ENGLISH from Z. Physik. Chem. (Frankfurt), v. 139A, 1928 p 439–452

(NASA-TT-F-10-780) CFSTI: HC$3.00/MF$0.65 CSCL 07D

The mechanism of monomolecular reactions, including dissociation and transformation, of larger molecules is explained on the basis of intramolecular energy fluctuations in elastic waves, initiating the reaction at the instant at which the amplitude, at a definite bond of the system, accidentally rises above a critical value due to interference of the waves. The fluctuation in energy of a given atom during a given time and the frequency with which the energy increases to an amount larger than μT (velocity constant times temperature) are calculated, substantiating the

empirical finding that the temperature-independent factor of the velocity contant of monomolecular reactions has an order of magnitude of 10^{14}. In a system with a weak bond (colliding molecules, molecules striking the wall) the energy transfer is less than in a system with a stable bond. The frequency of a chemical reaction or other transformation due to exceeding a critical elongation of a certain atom or to lifting the atom to a higher energy level is calculated. Author

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N67-23614# Air Force Cambridge Research Labs., Bedford, Mass. Data Sciences Lab.
AVERAGE DIGIT ERROR PROBABILITY AFTER DECODING RANDOM LINEAR CODES
John N. Pierce Oct. 1966 29 p refs *Its* Phys. and Mathematical Sci. Res. Papers, No. 275
(AFCRL-66-695; AD-645467) CFSTI: HC $3.00/MF $0.65

The post-decoding digit error probability averaged over all linear codes is compared with the average word error probability. It is shown that the ratio of these two averages approaches a nonzero limit with increasing code length at fixed code rate, and the value of the limit is determined. Author (TAB)

N67-23661*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
COMMUNICATIONS SYSTEMS RESEARCH
In its Supporting Res. and Advanced Develop. 28 Feb. 1967 p 308–338 refs (See N67-23641 12-11)

Block coding and synchronization studies are reported that deal with system determination from noisy measurements and adaptive multichannel reception with *M'ary* signals. A combinatorial communications investigation considers cyclic Hadamard matrixes, and a propagation study deals with the ray equation in the earth's atmosphere. The optimality of the square wave correlation function for the first order loop is discussed, as is the range-grated autocorrelation function for planetary radar applications. Information processing studies are concerned with the interpretation of spectra from the Mariner IV occultation experiment and with the synchronization of extremely weak binary signals. M.W.R.

N67-23662*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACECRAFT TELEMETRY AND COMMAND
F. J. Charles and F. L. Larson *In its* Supporting Res. and Advanced Develop. 28 Feb. 1967 p 339–353 refs (See N67-23641 12-11)

Probability distribution of the time to first loss of lock is investigated for the second order phase-locked loop. A heuristic argument is presented that explains the manner in which the probability distribution of the time to first lock occurs, and the measured distributions and their first moments are presented for various values of signal-to-noise ratio in the bandwidth loop. Results with the model give reasonable approximations for the data over the range of signal to noise ratios 0 db $< \rho <$ 5 db. M.W.R.

N67-23663*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
COMMUNICATIONS ELEMENTS RESEARCH
In its Supporting Res. and Advanced Develop. 28 Feb. 1967 p 354–369 refs (See N67-23641 12-11)

Radio frequency techniques and optical communications components are investigated. The former study considered 90-GHz millimeter wave components and techniques for applications to space communications and tracking. Water density in saturated air as a function of temperature can be accurately determined by a power series, and a fourth-order polynomial is given and graphed over a range of 32° to 100° F. Measurements of zenith atmospheric loss and noise temperatures versus zenith angle are used to determine antenna and input waveguide resistive losses, and an attempt is made to correlate these data with ground and humidity measurements. Equipment design and experimental results are reported for a feasibility program for a far infrared maser that uses an inversion in the rotational levels of gas molecules to produce stimulated emission at 81 μ wavelength in the far infrared region. A plot shows the undeflected molecular beam intensity as a decreasing function of the electrode potential, and that 75% of the beam is deflected from the collimation apertures with a 20-Kv electrode potential. M.W.R.

N67-23664*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACECRAFT RADIO
R. Woo *In its* Supporting Res. and Advanced Develop. 28 Feb. 1967 p 371–389 refs (See N67-23641 12-11)

An experimental study is reported for the multipacting between coaxial electrodes in the presence of a steady electric field, and results are included for the Mariner S-band turnaround ranging transponder improvement program. Probability distribution is investigated for guidance radar beam surface incidence angles, and a simplified method is presented for calculating the bit error probability of PCM/FM using discriminator detection. A high impact antenna study deals with a rectangular cup radiator. M.W.R.

N67-23831# Texas Univ., Austin. Electrical Engineering Research Lab.
A NOTE ON THE IDEALIZED RADAR RANGE EQUATION
J. J. Stephens 11 May 1966 11 p refs
(Contract DA-49-092-ARO-87)
(P-5; AD-640144) CFSTI: HC $3.00/MF $0.65

A complete statement of the idealized radar range equation is shown and compared to the result given by Probert-Jones. Author (TAB)

N67-23836# Environmental Science Services Administration, Boulder, Colo. Inst. for Telecommunication Sciences and Aeronomy.
SUMMARY OF 20–100 MHz PROPAGATION MEASUREMENT RESULTS OVER IRREGULAR TERRAIN USING LOW ANTENNA HEIGHTS
M. J. Miles and A. P. Barsis Nov. 1966 94 p refs
(IER-10-ITSA-10; AD-645023) CFSTI: HC $3.00/MF $0.65

Results of a comprehensive transmission loss measurement program over irregular terrain on 20, 50, and 100 MHz are presented in the form of transmission loss distributions and by examining the behavior of median and range values derived from the distributions as functions of various combinations of link parameters. Additionally, measured transmission loss medians for specific distances were compared with calculated values (based on smooth-earth diffraction) and with the results of similar measurements performed in a tropical jungle environment. Author (TAB)

N67-23850# University of Southern Calif., Los Angeles.
INFORMATION PROCESSING AND SIGNAL DESIGN THEORY
In its [Solid State, Appl. Electromagnetics and Plasmas, and Inform. Sci.] 30 Sep 1966 p 154–168 refs (See N67-23841 12-26)

Studies were made on: (1) *Signal Design Theory*—new signal sets which locally minimize probability of error at restricted bandwidth; (2) *Television Bandwidth Reduction Studies*—statistics of

probability distribution for frame difference signal and its time derivative; (3) *Laser Modulation and Detection Study*—transmission of right or left circular polarized laser pulses; (4) *Speech Signal Processing*—probability distribution of zero crossing rate of speech and music; (5) *Detection of Periodically Rotating Radar Targets*—theoretical radar echo model for clutter; (6) *Optical Coherence Theory*—analysis and optimization of systems which process electromagnetic fields carrying information; (7) *Optimal Estimation of Signal-to-Noise Ratio*—deterministic signals imbedded in Gaussian noise; and (8) *A Study of Laser Radar Systems*—laser propagation through stochastic channels. G.G.

N67-23851# University of Southern Calif., Los Angeles.
CODING THEORY AND AUTOMATA STUDIES
S. W. Golomb *In its* [Solid State, Appl. Electromagnetics and Plasmas, and Inform. Sci.] 30 Sep. 1966 p 169–173 refs (See N67-23841 12-26)

Discussed are: (1) *Automata*—nonlinear shift register model for large class of games; (2) Locomotion Automata—construction and testing of artificial quadruped based on finite state principles; (3) *Coding the Vertices of a Graph*; and (4) *Design Automation of Computers*—application of computers in design of computers. G.G.

N67-23862# Air Force Systems Commands, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RADAR LOCATION OF MOVING TARGETS
P. A. Bakulev 27 May 1966 317 p *refs* Transl. into ENGLISH of the book "Radiolokatsiya Dvizhushchikhsya Tseley" Moscow, Izd. Sovet. Radio, 1964 p 1–336
(FTD-MT-64-554; TT-67-60328; AD-644144) CFSTI: HC $3.00/MF $0.65

The book presents theory and technology of radar devices intended for radiolocation of moving targets on background of interferences of natural and artificial origin. In it are considered physical bases, principles of construction, and possibility of technical realization of radars of selection of moving targets (SDTs). The connection is analyzed between the tactical indices of radar SDTs and their technical parameters. It considers interaction of elements and nodes of radar stations SDTs; requirements presented to these elements and nodes are determined from the point of view of obtaining necessary quality of radar operation. There is conducted an analysis of different, in assignment, SDTs systems in their most characteristic operating conditions. Author (TAB)

N67-23913# European Space Vehicle Launcher Development Organization, Paris (France).
INTRODUCTION TO SYNTHESIS OF RADIO GUIDANCE AND TRACKING STATIONS
R. Cossert *In its* ELDO Tech. Rev., Vol. I, No. 4 [1966] p 275–333 refs (See N67-23911 12-30) CFSTI: HC $3.00/MF $0.65

In order to provide the non-specialist with an insight into the choice of the basic parameters, of a radio guidance and tracking station, the relations between basic station parameters, parameters describing the sources of error, and the associated error components are reviewed. These relations are illustrated graphically in terms of iso-error curves. Each of these iso-error curves is associated with an error component and yields the possible set of values of the parameters effecting this error component such that this error component is equal to the error component due to inaccurate knowledge of the velocity of light. There is nothing basically new in this treatment; the paper, however, gives the entire range of possible radio guidance and tracking stations that satisfy the above mentioned error criterion. These specifications can be used for comparison in the synthesis of highly accurate radio guidance and tracking stations. Author

N67-23926# Inter-Range Missile Flight Safety Group, White Sands Missile Range, N. Mex.
FLIGHT TERMINATION RECEIVER CATALOG
Jun. 1966 87 p Revised
(IRMFSG-306-64; AD-645323) CFSTI: HC $3.00/MF $0.65

The document provides a ready reference to UHF flight termination receivers used at U. S. Missile Testing Ranges. The information in this catalog is taken from manufacturers' specifications and is provided only as a guide. Nothing is implied as to the relative merits of any one receiver over another. The minimum specifications cited herein are representative of the individual range requirements. Detailed specification requirements must be obtained, and coordinated with the Lead Range. A history of flight usage and laboratory tests is included, where applicable. The receivers listed herein have been tested in accordance with Inter-Range Missile Flight Safety Group Document 303-64 Standardized Test Procedures - UHF Flight Termination Receivers, April 1964. TAB

N67-23949 Joint Publications Research Service, Washington, D.C.
EVALUATION OF OPERATION OF AN INFORMATION TRANSMISSION CHANNEL WITH PRIORITY
E. Ya. Dorokhov *In its* Soviet Res. in Automation and Cybernetics 13 Feb. 1967 p 36–44 refs (See N67-23946 12-10)

The probability of structural loss of information and average time of waiting for beginning of transmission are investigated for information and telemechanics systems. Single line queueing and preferential servicing of two Poisson flows are considered for the solution of the problems. An example is presented from a queueing installation for control and transmission of dispatches in a railroad system. Matrices are given for determining transition probabilities. K.W.

N67-24016# Naval Research Lab., Washington, D. C.
CROSS MODULATION IN THE SCAMP SIGNAL PROCESSOR Final Report
Samuel F. George, Oliver D. Sledge, and John E. Abel 21 Nov. 1966 25 p refs
(NRL-6443; AD-645053) CFSTI: HC $3.00/MF $0.65

When two or more signals of different frequencies are fed simultaneously into the input of a limiter, cross-modulation products exist in the output. Such a situation occurs in the Scamp (Single-Channel Monopulse Processor) signal processor when the sum signal and both difference signals (azimuth and elevation) of a monopulse system are processed in a common limiter. The resultant cross modulation can produce deleterious effects, even though the spectra of the three input signals do not overlap. By the use of approximation methods, formulas are developed for the limiter outputs, showing the dependence of the cross-modulation terms on the input amplitudes and phases of both difference channels. Curves are presented illustrating the amount of cross modulation for several arrangements of channel spacing. The largest errors occur when the difference channels are symmetrically located on either side of the reference channel. The errors are substantially reduced by an unsymmetrical or a noncontiguous channel orientation. Experimental results on a simulated Scamp processor agree favorably with the theory. Author (TAB)

N67-24034# Japan Broadcasting Corp., Tokyo. NHK Technical Research Labs.
ULTRADIRECTIONAL CONDENSER MICROPHONE
Nov. 1966 8 p *Its* Serial No. 102
CFSTI: HC $3.00/MF $0.65

Design requirements, design problems, construction, and performance involved in research on ultradirectional condenser microphones for television studio use are described. An experimental model of the second-order pressure gradient type was designed and built by combining two first-order directional condenser microphones differentially. Testing the microphone in an auditorium

seating about 300 people indicated that its working distance from the sound source can be made 1.5 times as large as that for an ordinary cardioid unidirectional microphone. L.E.W.

N67-24035# Japan Broadcasting Corp., Tokyo. NHK Technical Research Labs.
GROUP TALK MICROPHONE
Nov. 1966 7 p *Its* Serial No. 103
CFSTI: HC $3.00/MF $0.75

Details are given on the theoretical analysis, construction, and performance of a microphone with a doughnut-shaped directional pattern (omnidirectional in the horizontal plane and bidirectional in the vertical plane) for group talking. The construction of the microphone consisting of two bidirectional ribbon microphones with their outputs combined via a 90° phase-shift method is outlined. L.E.W.

N67-24036# Japan Broadcasting Corp., Tokyo. NHK Technical Research Labs.
VARIABLE DIRECTION MICROPHONE
Nov. 1966 7 p *Its* Serial No. 104
CFSTI: HC $3.00/MF $0.65

The development of a method for moving a boom-mounted directional microphone by electrical remote control from the control room of a television studio is considered. The construction of a variable direction microphone with a principal axis that can be rotated 360° by combining two bidirectional ribbon microphones and an omnidirectional microphone by using a bridge circuit is discussed. Details are given on the theoretical analysis, fabrication, and performance. L.E.W.

N67-24052# RAND Corp., Santa Monica, Calif.
GAUSSIAN PROCESSES WITH STATIONARY INCREMENTS POSSESSING DISCONTINUOUS SAMPLE PATHS
M. B. Marcus Dec. 1966 20 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(RM-5226-PR; AD-645079) CFSTI: HC $3.00/MF $0.65

A presentation of new properties of Gaussian processes with stationary increments. The results of the study concern conditions for which the sample paths of these processes are not continuous, and will be useful in problems where Gaussian processes occur. The memorandum is directed to specialists in communication theory and other fields of applied probability theory and should be of interest to applied scientists concerned with engineering analysis. Author (TAB)

N67-24059# Environmental Sciences Services Administration, Boulder, Colo. Inst. for Telecommunication Sciences and Aeronomy.
A METHOD OF MEASURING THE MULTIPATH COMPONENTS OF A FIELD
C. C. Watterson Aug. 1966 47 p refs
(Contract AF 30(602)-2385)
(IER-6-ITSA-6; AD-645021) CFSTI: HC $3.00/MF $0.65

A description and analysis is presented of a method of making field-strength measurements in a multipath field from which computations can be made of the amplitude, phase, and angle of arrival of each of a number of coherent elliptically-polarized plane-wave multipath components. The method requires that the amplitude and phase of the received signal from a moving dipole or other small-aperture antenna be measured as the antenna is moved successively along three orthogonal straight-line paths. The dynamic range of the amplitude of the multipath components which can be measured is approximately equal to the ratio of the amplitude of the strongest component to the magnitude of the errors of measurement. The angular resolution is approximately equal to the beamwidth of an antenna whose aperture equals the distance of movement of the dipole. The errors in the solutions are least for the strongest multipath components and greatest for the weaker components. In a computer evaluation which used measurements of two-figure accuracy, the stronger component errors were less than one-tenth of a dB in amplitude, several tenths of a degree in phase and about one-tenth of a degree in angle of arrival. Measurements of an actual multipath field have demonstrated the practicality of the technique. Author (TAB)

N67-24214 Joint Publications Research Service, Washington, D.C.
SOME PROBLEMS IN INFORMATION TRANSMISSION AND PROCESSING
V. I. Siforov *In its* Tech. Cybernetics No. 1, 1967 14 Apr. 1967 p 115–126 refs (See N67-24201 12-10)

Results are discussed from a number of works which have come out in the last three years in the area of information transmission theory, encoding theory, the selection of signals, pattern recognition, and also in the area of information transmission to interplanetary distances. Author

N67-24215 Joint Publications Research Service, Washington, D.C.
INCREASING THE RELIABILITY OF INFORMATION TRANSMISSION IN COMPLEX SYSTEMS USING COMPUTERS
Yu. N. Mel'nikov *In its* Tech. Cybernetics No. 1, 1967 14 Apr. 1967 p 127–137 refs (See N67-24201 12-10)

Information processes are considered in complex systems with information exchange between computers. Requirements on the transmission of information in such systems are discussed. Means are noted for approximate determination of the coefficient of importance of various communications. A procedure is proposed for distribution of redundancy taking into account the restrictions with respect to the carrying capacity of the channels and machine time. Author

N67-24216 Joint Publications Research Service, Washington, D.C.
A DECODING METHOD FOR ARITHMETIC CODES WITH SINGLE ERROR CORRECTION
Yu. G. Dadeyev *In its* Tech. Cybernetics No. 1, 1967 14 Apr. 1967 p 138–142 refs (See N67-24201 12-10)

A decoding method for arithmetic codes with correction of single errors introduced in the (i+1)bit is proposed as suitable for execution on a computer. Author

N67-24315# Library of Congress, Washington, D. C. Aerospace Technology Div.
UNDERGROUND ELECTROMAGNETIC WAVE PROPAGATION
Stuart G. Hibben *In its* Foreign Sci. Bull., Vol. 3, No. 3 Mar. 1967 p 20–32 refs (See N67-24312 12-23)

A review is given of recently published Soviet results on factors which govern subsurface em wave propagation. The work covers measurement of earth conductivity and dielectric constant, frequency characteristics, and design considerations for near-surface and subsurface antennas. A few results of subsurface antenna pattern and gain measurements are given. Author

N67-24373# Navy Underwater Sound Lab., New London, Conn.
ELECTRIC FIELD, RADIATION RESISTANCE, AND GAIN OF SLOW WAVE ANTENNAS
Dennis E. Fessenden and Kurt F. Hafner, Jr. 9 Dec. 1966 27 p refs
(USL-783; AD-645804) CFSTI: HC $3.00/MF $0.65

The slow wave antenna is considered in this report as a special case of a vertical monopole with a current of arbitrary phase velocity. The electric field, radiation resistance, and power gain are discussed in general as functions of the antenna phase velocity. Particular attention is given to the special cases of

one-quarter and three-quarter wavelength antennas. The limiting values of the parameters as the phase velocity along the antenna approaches zero are discussed. Conclusions are reached concerning the maximum expected gain of a slow wave antenna. Author (TAB)

N67-24409# Washington State Univ., Pullman. Coll. of Engineering Research Div.
INVESTIGATION OF TRANS-POLAR H. F. RADIO PROPAGATION Final Report
David H. Schrader and George Huang 27 Oct. 1966 44 p refs
(Contract AF 19(628)-5665)
(Rept.-67-166; AFCRL-66-783; AD-647772) CFSTI: HC $3.00/MF $0.65

A study of polar propagation of HF radio signals from Andoya, Norway, and from Thule, Greenland, to Pullman, Washington, was conducted. The signals were generated by step-frequency sounders operating from 4 MHz to 32 MHz. The study consisted of a study of the regular diurnal and seasonal variations of the MOF and LOF and a study of the effects of solar flares on the reception. During periods when the ionsphere is disturbed by particle flux from solar flares, the MOF decreases initially and the LOF increases some nine hours later on the average. Reception of signal is often lost during periods of either visual or radio aurora. The Andoya-Pullman path was more sensitive to such disturbances than the Thule-Pullman path. The MOF correlates negatively with the daily magnetic K sub p indices of the preceding day. Author (TAB)

N67-24420# Library of Congress, Washington, D. C. Aerospace Technology Div.
TRACKING OF MISSILES AND SPACE VEHICLES Survey of Foreign Scientific and Technical Literature
Stuart Hibben 16 Dec. 1966 90 p refs
(ATD-66-140; Rept.-26; AD-647888) CFSTI: HC $3.00/MF $0.65

The 81 abstracts are arranged alphabetically by author within the following categories: (1) Tracking facilities and institutions (3 entries); (2) Tracking equipment and techniques (14 entries); (3) Precision baseline establishment (3 entries); (4) Slant range and range rate measurement (1 entry); (5) Angle and angular rate measurement (4 entries); (6) Absolute time measurement (2 entries); (7) Frequency measurement and standards (7 entries); (8) Relative time or delay time measurement (6 entries); (9) Velocity of light determination (2 entries); (10) Radio astronomy (15 entries); (11) Technological advances (24 entries). A bibliography comprising 81 entries is presented at the end of the report. Author (TAB)

N67-24489# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TO DEFINE THE BOUNDARIES OF INDIVIDUAL APPLICATION OF EXPONENTIAL AND NORMAL LAWS OF TIME DISTRIBUTION IN FAILURES OF ELEMENTS OF RADIO ELECTRONIC EQUIPMENT [K UTOCHENENIYU GRAINTS RAZDEL'NOGO PRIMENENIYA EKSPONENTSIAL' NOGO I NORMAL'NOGO ZAKONOV RASPREDELENIYA VREMEN OTKAZOV ELEMENTOV RADIOELEKTRONNOY AP-PARATURY]
O. Ya. Gel'man 12 Dec. 1966 9 p refs Transl. into ENGLISH from Izv. Akad. Nauk Latv. SSR, Ser. Fiz. i Tekhn. Nauk (Riga), no. 4, 1964 p 119–123
(FTD-HT-66-524; TT-67-61115; AD-647719) CFSTI: HC $3.00/MF $0.65

The minimum of the generalized function of time distribution in the failures of radioelectronic equipment is studied with the aim of defining the boundary values of a parameter at which a separate application of the exponential and regular laws is possible for the evaluation of reliability. Author (TAB)

N67-24492# Sperry Rand Research Center, Sudbury, Mass.
EVALUATION OF PSEUDO-RANDOM DOT-SCANNING TELEVISION SYSTEMS Final Report, 1 Oct. 1965–30 Nov. 1966
L. Kaufman, A. J. Lincoln, and C. B. Pitblado Jan. 1967 64 p
(Contract AF 19(628)-5672)
(SRRC-CR-66-49; AFCRL-67-0004; AD-647599) CFSTI: HC $3.00/MF $0.65

The broad objectives of this program were to obtain experimental data and theoretical analyses of the psychovisual factors relevant to the subjective and objective properties of display systems. Emphasis has been placed upon the contribution of scan format to the maintenance of useful pictorial information in narrow-bandwidth television displays. Consideration was also given to the use of stereoscopic vision as a potential avenue for enhancement of visual performance. Basic psychophysical techniques were employed to define the significant parameters which lead to optimum performance of visual tasks. Parameters varied were scan format, scan rate, display persistence, mode of presentation (i.e., stereoscopic, monocular, or dichoptic), target dimensions, target shape and complexity, and target contrast. Three broad classes of perceptual response may be identified: detection, recognition, and discrimination; tasks selected for the experiment constitute a sampling of all three of these basic categories. The following visual phenomena have appeared in these studies to bear upon performance of various visual tasks with narrow-bandwidth displays: (1) discriminability between brightness-modulated perturbations in the scan substructure and featureless, unilluminated space; (2) spontaneous closure and organizing phenomena, occurring in the scan substructure; (3) stereopsis and (4) visual brightness averaging over inhomogeneously illuminated space. Author (TAB)

N67-24500# Naval Air Development Center, Johnsville, Pa. Aero-Electronic Technology Dept.
EFFECTS OF TAPE RECORDER WOW AND FLUTTER ON SONAR DATA
Donald J. Savage 1 Feb. 1967 33 p refs
(NADC-AE-6626; AD-647793) CFSTI: HC $3.00/MF $0.65

WOW and flutter impose restrictions in dynamic range and signal to noise measurements and use of the information generated here can help extend the analysis and evaluation of analog recorded data. Despite errors, high performance laboratory quality analog recorders can be useful for narrowband analysis of low frequency data. Author (TAB)

N67-24633*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
TEMS RADAR ERROR MODEL REGRESSION ANALYSIS RESULTS FROM THE SATURN AS-201, AS-202, AND SA-203 FLIGHT TESTS
Bobby G. Junkin 3 Mar. 1967 55 p refs
(NASA-TM-X-53585) CFSTI: HC $3.00/MF $0.65 CSCL 17I

The tracking system error model studies method for evaluating systematic errors in radar tracking system measurements is illustrated with data from the 201 and 202 Apollo–Saturn tests and the 203 Saturn test. On the basis of results from these three tests, it appears that error model coefficient values are not repeatable from test to test. It is also noted that the standard deviations for several of the coefficients do not vary significantly from radar to radar on the three flights. The average random errors remaining in the residuals for the three flights are .0053 degrees and .0080 degrees in azimuth and elevation, respectively, and 3.55 meters in range. The occurrence of the various terms on each test and for each radar indicates that no less than five and no more than nine terms are required in the truncated error models. Author

N67-24749# Sylvania Electric Products, Inc., Mountain View, Calif. Electronic Defense Labs.

SIGNAL-ADAPTIVE CONTROL FOR ANTENNA PEDESTALS

F. W. Smith Ft. Monmouth, N. J., Army Electron. Command, Mar. 1967 39 p

(Contract DA-28-043-AMC-01829(E))

(EDL-M956; ECOM-01829-M956; AD-646984) CFSTI: HC $3.00/MF $0.65

Signal adaptive controllers are developed and tested by simulation for three antenna pedestal systems. These controllers use time-optimal or quasi time-optimal control for large errors and then change to conventional proportional control for small errors. Author (TAB)

N67-24750# Sylvania Electric Products, Inc., Mountain View, Calif. Electronic Defense Labs.

WAVEGUIDE-FED LOG PERIODIC ANTENNAS

N. Barbano Mar. 1967 29 p refs

(Contract DA-28-043-AMC-01829(E))

(EDL-M1017; ECOM-01829-M1017; AD-646985) CFSTI: HC $3.00/MF $0.65

Almost all log periodic antenna designs incorporate a parallel or tapered-vee transmission line, as the feeding mechanism for the radiating elements. These lines propagate the TEM mode. Techniques whereby log periodic antennas may be fed with waveguides are introduced in this report. In this case the dominant TE sub 10 mode of the waveguide is used in the feeder transmission line application. Methods of coupling energy to the radiating elements of the log periodic structure by probes inserted in the waveguide are presented. It is shown that an array may be fed either on the broad wall or narrow wall of the waveguide. The useful operating frequency range of these antennas is limited to the normal waveguide bandwidth. The waveguide-fed method is primarily useful for monopole arrays although dipole arrays can also be fed in this manner. Results of measurements performed on various antenna models are discussed. It is shown that VSWR responses below 2:1 and absolute radiation pattern gains above 10 db can be achieved. The effects of different design parameters on antenna characteristics are discussed. In addition, a requirement is presented in which either the element lengths or element spacings must be compensated to achieve constant H-plane radiation patterns. Author (TAB)

N67-24759# Syracuse Univ. Research Inst., N. Y. Electrical Engineering Dept.

ANTENNA ARRAYS WITH PARTIALLY TAPERED AMPLITUDES Scientific Report

Bradley J. Strait 25 Jan. 1967 32 p refs

(Contract AF 19(628)-5882)

(AFCRL-67-0088; SR-2; AD-647187) CFSTI: HC $3.00/MF $0.65

A new technique was presented for linear array design using a form of limited amplitude tapering. It was shown that desirable pattern characteristics can be achieved using an amplitude distribution that is uniform over all but a few of the outermost pairs of array elements resulting in a partially uniform array. This method applies equally well to broadside and endfire arrays and can be used to place pattern nulls in one or more specified directions or to eliminate virtually all radiation over one or more sectors of space. When compared with Dolph–Chebyshev arrays corresponding to the same sidelobe levels, partially uniform arrays provide a simpler excitation scheme in general and, in some cases higher directive gain and a lower maximum-to-minimum excitation ratio. Both theoretical and experimental examples are given. Author (TAB)

N67-24769# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

A METHOD OF PRODUCING WAVES WITH A DOPPLER FREQUENCY SHIFT IN THE OPTICAL RANGE

Ye. G. Ritter and S. M. Naumov 12 Dec. 1966 6 p Transl. into ENGLISH from Russian Patent no. 168764 (Appl. no. 879907/26-25, 4 Feb. 1964) 2 p

(FTD-HT-66-674; AD-647724) CFSTI: HC $3.00/MF $0.65

The method of producing waves of a Doppler frequency shift in the optical range is different in that to reduce the angular and steric shift of the frequency shifted beam and to produce smoothly tunable Doppler frequencies retaining the constant amplitude of the Doppler signal, translational motion of the reflecting mirror surface is accomplished by an immobile mirror and a prism of full internal reflection mounted on a rotating disc. Author (TAB)

N67-24784# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.

U. S. NAVY DOPPLER TRACKING SYSTEM TRANET

Charles A. Dunnell Dec. 1966 37 p refs

(Contract NOw-62-0604-c)

(APL-TG-874; AD-646904) CFSTI: HC $3.00/MF $0.65

The TRANET satellite tracking network of radar receiving stations and other facilities acquires and processes doppler-frequency shift data from the signals of suitably equipped near-earth satellites. A small man-portable station, currently under development, will ultimately replace the van-mounted stations. The system is capable of handling 40 to 50 passes per station per day or between 480 and 600 passes per day for the basic network of earth stations. As many as ten satellites can be handled by full-time operation of the network and still maintain maximum accuracy. Data attrition from all causes is below 10 percent. The APL Time-and-Frequency Laboratory generates signals that are used by the TRANET stations to ensure the accuracy of their time and frequency standards. The TRANET Control Center serves as the hub of the TRANET network. It receives data from the stations and advises the stations on the status of the satellites and of their performance. Data from the Control Center are reduced by the APL Computing Center and by the Naval Weapons Laboratory. TRANET provides high-density high-accuracy data for a large number of satellites in a form ready for the computing process. Currently TRANET measures doppler frequency with an accuracy of one part in 10 to the 11th power and satellite position with an accuracy of 10 meters. Author (TAB)

N67-24788# Naval Ordnance Lab., Corona, Calif.

SELECTION OF A VLF RECEIVING ANTENNA FOR THE BOLIVIAN SOLAR ECLIPSE SITE

Verne E. Hildebrand 31 Oct. 1966 42 p refs

(NOLC-694; AD-646629) CFSTI: HC $3.00/MF $0.65

Properties of the ionosphere D region under conditions of a solar total eclipse were measured utilizing a VLF receiving system in Bolivia. The signals were transmitted from southeast Brazil along the path of totality for the 12 November 1966 solar eclipse. This report describes the study conducted for the selection of a VLF receiving antenna which was to provide maximum discrimination against atmospheric noise in the 9- to 31-kc band. The antenna selected was a two-loop superdirective antenna with the loop elements rotated 25 degrees from the antenna axis. The report describes the criteria utilized in selecting the antenna, discusses other possible choices, and evaluates the performance of the antenna in the light of various component tolerances. Author (TAB)

N67-24798# Navy Underwater Sound Lab., New London, Conn.

GENERATION OF TWO-DIMENSIONAL OPTICAL SPATIAL AUTO- AND CROSS-CORRELATION FUNCTIONS

Hans J. Wilde 13 Dec. 1966 40 p refs

(USL-744; AD-646554) CFSTI: HC $3.00/MF $0.65

The report describes the generation of accurate two-dimensional auto- and cross-correlograms as related to optical signal processing. The development and design considerations of a simple electro-optical equipment are outlined and the parameters explained, and the principle of operation is discussed. The report

then shows possible applications for sonar displays in the field of target recognition and tracking. The final sections deal with correlograms of small objects and complex images. Author (TAB)

N67-24808# Harry Diamond Labs., Washington, D. C.
TELEMETRY RING ANTENNA
Howard Bassen and Ronald Jantz Dec. 1966 21 p refs
(HDL-TR-1335; AD-646762) CFSTI: HC $3.00/MF $0.65

A quarter-wavelength ring antenna was developed to telemeter active fuzes in flight with a minimum modification to fuze or artillery round. Using principles of strip transmission line theory, general design criteria were established to maximize radiation efficiency within a fixed form factor. Electroplating and selective machining provided for economical, accurate production. Antenna field strength measurements varified expectations as to adequate radiation efficiency and a highly symmetric, ring-shaped pattern. This type antenna provides the ability, for the first time, to telemeter in-flight active fuzes without major shell modification.
Author (TAB)

N67-24824# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
INTELLIGIBILITY TEST METHODS AND PROCEDURES FOR THE EVALUATION OF SPEECH COMMUNICATION SYSTEMS Final Report
Carl E. Williams, Michael H. L. Hecker, Kenneth N. Stevens, and Barbara Woods Dec. 1966 65 p refs
(Contract AF 19(628)-5659)
(ESD-TR-66-677; AD-646781) CFSTI: HC $3.00/MF $0.65

In further exploring the Modified Rhyme Test (MRT), a recently developed intelligibility test designed for the evaluation of speech communication systems under operational military conditions, research has been conducted in the following areas: (a) the relation between MRT scores and other intelligibility test scores for various types and levels of speech distortion; (b) the influence of the closed-response format and listening experience on MRT scores; and (c) speaker intelligibility and the selection of speakers for recording the test lists. The present report describes the work undertaken in each of these areas. The ultimate objective of the work is the development of valid procedures for the efficient evaluation of speech communication systems. The major experimental results demonstrate that (1) the relation between scores obtained with different intelligibility test materials is not unique but depends considerably on the type of speech distortion employed, (2) neither the closed-response format nor prior listening experience appreciably affects MRT scores, and (3) less intelligible speakers tend to be those whose voiceless consonants are generated with lower intensity, particularly in word-final position. Author (TAB)

N67-24832# Navy Underwater Sound Lab., New London, Conn.
UTILIZATION OF THE RECIPROCITY THEOREM TO DETERMINE THE NEAR FIELD AIR-TO-SUBSURFACE PROPAGATION FORMULAS
Peter R. Bannister 22 Nov. 1966 24 p refs
(USL-786; AD-646855) CFSTI: HC $3.00/MF $0.65

The electric and magnetic field components produced by vertical and horizontal dipoles (both electric and magnetic types) located at or above the surface of a plane, conducting, homogeneous earth are derived for the near field range. The height h of the transmitting antenna is > or = 0(+), while the depth z of the receiving antenna is < or = 0(-) (air-to-subsurface propagation). Ionospheric effects are neglected. The derivations are based upon application of the reciprocity theorem to previously derived field components. It is observed that these equations reduce to well-known expressions when the horizontal separation between the transmitting and receiving antennas is much greater than h. Author (TAB)

N67-24838# Lincoln Lab., Mass. Inst. of Tech., Lexington.
ON THE EQUIVALENCE OF LINEARIZED KALMAN FILTERS
M. Athans 11 Jan. 1967 26 p ref
(Contract AF 19(628)-5167)
(TN-1967-6; ESD-TR-67-20; AD-646550) CFSTI: HC $3.00/MF $0.65

The purpose of this note is to examine the relationships of the Kalman filters which can be used to estimate the linearized state of two different state-variable representations of the same nonlinear system. It is shown that, to within first order effects, the choice of the coordinate system for the construction of the Kalman filter is immaterial. Author (TAB)

N67-24852# Federal Aviation Agency, Washington, D. C. Research and Development Service.
IMPROVED ATC TRANSPONDER ANTENNA PERFORMANCE
Kenneth Wise Dec. 1966 22 p
(FAA-RD-66-103; AD-646877) CFSTI: HC $3.00/MF $0.65

The document describes the results of a study to determine the best way to improve the performance of the ATC transponder antenna. The background of the problem is presented and the advantages and disadvantages of some of the many solutions, past and present, are discussed. A strong recommendation is made for a combined transponder/antenna system approach as the solution to the problem. The details of the proposed approach are presented in the form of an engineering requirement suitable for development effort. Author (TAB)

N67-24864# Technical Univ. of Denmark, Lyngby. Lab. of Electromagnetic Theory.
SQUARE VAN ATTA REFLECTOR WITH OR WITHOUT A CONDUCTING PLATE
Tove Larsen and Erik Drago Nielsen Aug. 1966 35 p refs
(Contract AF 61(052)-794)
(AFCRL-66-640; SR-5; AD-647695) CFSTI: HC $3.00/MF $0.65

A theoretical investigation of a square Van Atta reflector consisting of half wave dipoles mounted above and parallel to a conducting plate was carried out. Each pair of antenna elements was represented by an equivalent circuit, using x-circuits for the transmissionlines. The mutual impedance between the antenna elements and the reradiation both from the elements and from the plate was taken into account. The influence of the conducting plate was treated by using the theory of images. The scattering cross section of the reflector was examined analytically and numerically. The numerical results were compared with experimental results obtained by others. Author (TAB)

N67-24872# Boeing Co., Seattle, Wash. Geo-Astrophysics Lab.
BEHAVIOR OF NON-RAYLEIGH STATISTICS OF MICROWAVE FORWARD SCATTER FROM A RANDOM WATER SURFACE
C. I. Beard Dec. 1966 47 p refs
(D1-82-0587; AD-647177) CFSTI: HC $3.00/MF $0.65

Measurements of the phase-quadrature components of the microwave field forward scattered from random water waves have continued since the observance in 1963 of non-Rayleigh probability distributions of the incoherent scattered field. Measurements of the variances of the phase-quadrature components of the incoherent field at various phase angles with respect to the coherent field have yielded new results not explained by plane-wave theory: (a) The equiprobability ellipse of the phase-quadrature components of the incoherent field rotates as a function of apparent surface roughness. (b) The rotation of the equiprobability ellipse varies more rapidly with roughness for 'narrow' surface illumination and less rapidly for 'broad illumination. (c) The greatest ratio of the two variances appears to rise from unity with increasing roughness to

a peak value (maximum departure from Rayleigh), and presumably decreases at greater roughnesses. The data indicate that non-planar illuminating and receiving wave fronts may be responsible for these divergences from plane-wave theory. New theoretical development is needed to include the effects of wavefront sphericity. Author (TAB)

N67-24874# Parke Mathematical Labs., Inc., Carlisle, Mass.
MATHEMATICAL RESEARCH ON CODING THEORY Final Report, Feb. 1964–Nov. 1966
Dec. 1966 23 p
(Contract AF 19(628)-3826)
(AFCRL-67-0010; AD-646876) CFSTI: HC $3.00/MF $0.65

The report presents a summary of the research performed under the contract in the field of Coding Theory. Since the work performed has been amply documented in the 23 technical memoranda and 9 scientific reports issued and available upon request, this report gives a chronological list of the publications with a summary of and/or comment on their content. The main effort (represented by 11 technical memoranda and 8 scientific reports) was directed toward an axiomatic theory of error-correcting, variable length codes. TAB

N67-24880# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
ADAPTIVE RECEIVERS FOR DIGITAL SIGNALING OVER RANDOM OR UNKNOWN CHANNELS
John G. Proakis Dec. 1966 308 p refs
(Contract Nonr-1866(16))
(TR-516; AD-647503) CFSTI: HC $3.00/MF $0.65

The problem in digital communications treated herein can be stated as follows: There is a transmitter which chooses and sends, in any signaling interval of duration T seconds, one of M possible signaling waveforms over a channel which is modeled as a linear filter and an impulse response that is unknown or randomly time-varying. The transmitted waveform is also corrupted by additive Gaussian noise. At the receiving point a receiver is to be designed which processes the received signal and decides with minimum probability of error which one of the M waveforms was transmitted in every signaling interval. Treated in detail is a channel which imparts an unknown or slowly and randomly time-varying gain and phase shift to the signal which is transmitted in each signaling interval. For this channel the receiver which minimizes the probability of error is specified and its performance is evaluated for binary orthogonal signaling and M-phase signaling. Basically, the receiver uses an estimate of the channel gain and phase shift in detecting the waveform received in each signaling interval. Furthermore, it is shown that in addition to detecting the transmitted information sequence, this receiver continuously estimates the channel gain and phase shift either from the information-bearing waveform or by means of a pilot waveform which is transmitted for the puprose of measuring the channel. The performance of the receiver is evaluated in terms of its probability of error for binary orthogonal signaling and M-phase signaling in the general context of Lth order diversity reception. For M-phase signaling we give the probabilities of a binary digit error and the probability of a character error. Author (TAB)

N67-24910# Electro Technical Analysis Corp., Tucson, Ariz.
FREQUENCY ASSIGNMENT STUDIES Quarterly Progress Report, 1 Aug.–31 Oct. 1966
Alfred J. Hoehn and Thomas W. McCurnin Dec. 1966 58 p refs
(Contract DA-28-043-AMC-01232(E))
(ECOM-01232-4; QPR-4; AD-646813) CFSTI: HC $3.00/MF $0.65

A study was made to improve electromagnetic compatibility in the field army through development of frequency-assignment practices. A modeling method for fm receivers is presented which takes into account the action of the demodulator, and which permits consideration of modulation of all signals. Modulation is in the form of random noise, which is a reasonably good approximation to voice signals and also to the signals resulting from multichannel, multiplexed telephone transmissions of the radio-relay type. TAB

N67-24924# Lincoln Lab., Mass. Inst. of Tech., Lexington.
MICROWAVE SCATTERING PARAMETERS FOR NEW ENGLAND RAIN
R. K. Crane 3 Oct. 1966 73 p refs
(Contract AF 19(628)-5167)
(TR-426; ESD-TR-66-447; AD-647798) CFSTI: HC $3.00/MF $0.65

Scattergrams of attenuation coefficient, effective reflectivity factor, single-scattering albedo, and radio refractivity vs liquid-water content, rain rate, and reflectivity factor are presented for a raindrop temperature of 0.0C and frequencies of 1.29, 2.80, 9.35, 15.5, 35.0, 70.0, and 94.0 GHz. The scattergrams were computed using Mie theory to compute the scattering parameters for single raindrops, and single-scattering theory to compute the integrated scattering effects of an ensemble of raindrops. Measured drop-size distributions were used to generate the scattergrams. Author (TAB)

N67-24931# Litton Systems, Inc., Waltham, Mass. Signal Processing Dept.
RESEARCH IN MULTIPLE ALTERNATIVE COMMUNICATIONS Final Report, 1 May 1964–31 Oct. 1966
William B. Floyd and Albert H. Nuttall 30 Nov. 1966 204 p refs
(Contract AF 19(628)-4081)
(AFCRL-67-0030; AD-647404) CFSTI: HC $3.00/MF $0.65

A generic digital communication method, called q-M-ary transmission, is introduced and evaluated under the conditions of phase coherent and two types of phase incoherent reception of signals transmitted through a non-fading medium. The basic feature of this method is the use of M-ary transmission alphabets employing only q different waveforms to synthesize the transmitted signals. Special attention is directed to the effect of bandwidth constraints on the performance attainable with this method, and to the value of high-order M-ary transmission alphabets, when implemented with this method. Comparison of a particular form of this method (q = 2) with conventional binary coding indicates that at least a few dB improvement is provided by the 2-M-ary method with M large, even when bandwidth is severely limited. One of the types of phase incoherent operating modes is found to produce very nearly the same performance as that achievable with optimum phase coherent operation, when the transmission alphabet is large. Author (TAB)

N67-24941# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
A THEORETICAL STUDY OF A LONG DIELECTRIC-COATED CYLINDRICAL ANTENNA
Chung-Yu Ting Jan. 1967 24 p refs
(Contract Nonr-1866(32))
(TR-517; AD-647363) CFSTI: HC $3.00/MF $0.65

By applying the Wiener-Hopf technique, the reflection coefficient of the transmission current at the end of a dielectric-coated antenna can be expressed in a single integral form. This result, when used with the solution of an infinite dielectric-coated cylindrical antenna, yields the input admittance and the current distribution of a long dielectric coated antenna. It is found that unlike the locus of the admittance of a bare cylindrical antenna which converges to a point as the antenna gets longer and longer, the locus of the input admittance of the dielectric-coated antenna becomes a circle. Also, due to the reflection of the transmission current back and forth, a standing wave with surface wave length is formed along the antenna. Author (TAB)

N67-24943# Ohio State Univ. Research Foundation, Columbus.
A DESCRIPTION OF THE COHERING RECEIVER TO BE USED IN THE OSU SATELLITE COMMUNICATIONS FACILITY Interim Report
Stephen T. Cost Griffiss AFB, N. Y., RADC, Jan. 1967 31 p refs
(Contract AF 30(602)-3601)
(Rept.-1963-8; RADC-TR-66-666; AD-647274) CFSTI: HC $3.00/MF $0.65

The report describes the receiver which was designed for use with the Ohio State University Satellite Communications phased array. In particular, that part of an individual receiver channel called the cohering receiver (a single-conversion, phase-locked loop) is described in detail. Included are discussions of the design parameters for the IF section and the phase-locked loop, circuit diagrams, and the testing procedure carried out to determine receiver characteristics. Author (TAB)

N67-24947# Defense Research Corp., Santa Barbara, Calif.
WIDTH-MODULATED PULSE-DOPPLER WAVEFORMS FOR CLUTTER REJECTION
G. W. Deley Jun. 1966 41 p refs Prepared for Lincoln Lab., MIT
(Contract AF 19(628)-5167); ARPA Order 498)
(TM-364; ESD-TR-67-53; AD-647195) CFSTI: HC $3.00/MF $0.65

A single short radar pulse provides rejection of clutter distributed in range on the basis of range resolution only. A coherently integrated train of equally spaced pulses (a pulse burst) can provide rejection of clutter by both range and Doppler resolution. The doppler rejection capabilities of a pulse burst can be greatly improved either by amplitude modulation of the burst or, to a somewhat lesser extent, by pulse-width modulation of the burst. For example, a burst of thirty pulses can be width modulated to provide 28.5 db more rejection of clutter of a doppler shift half way between ambiguities than can a single pulse with the same range resolution. With a different width-modulated thirty-pulse burst, greater than 20 db more rejection of clutter than that provided by a single pulse can be obtained over a wide region of clutter doppler shifts. Linear frequency modulation of the pulses of a pulse-width modulated burst appears to be unattractive. Author (TAB)

N67-24951# Lincoln Lab., Mass. Inst. of Tech., Lexington.
COHERENT PULSE TRANSMISSION THROUGH RAIN
R. K. Crane 27 Dec. 1966 31 p refs
(Contract AF 19(628)-5167)
(TN-1966-63; ESD-TR-66-60; AD-646823) CFSTI: HC $3.00/MF $0.65

The problem of received signal degradation for coherent pulse transmission through a rain scattering volume was investigated for large bandwidth transmission at 4.0, 8.0, 15.5 and 34.86GHz. Calculations of pulse length and total pulse energy were made for different path lengths through the rain volume. The calculations were made for models of heavy and extreme rainfall, using rain rates 49.0 and 196.3mm/hr. The results of the computations show that for the rain rates considered, the dominant cause of signal degradation is attenuation. Negligible pulse lengthening was noted at 34.86GHz. For rain rates above 196mm/hr. and frequencies of 15.5 and 8.0GHz, measurable values of pulse lengthening were calculated for bandwidths above 2.0GHz. At 4.0GHz, measurable values of pulse lengthening were obtained for both rain rates considered. Author (TAB)

N67-24999# Naval Research Lab., Washington, D. C.
CONTROL AND MEASUREMENT OF ANTENNA POLARIZATION
P. J. Allen Jul. 1966 44 p refs
(NRL-MR-1734; AD-646713) CFSTI: HC $3.00/MF $0.65

The effectiveness of an antenna in receiving a polarized wave is very dependent upon the state of polarization of both the antenna and of the wave being received. While the degree of coupling between wave and antenna, or between two antennas, can be determined theoretically, a qualitative appreciation of how antennas and polarized waves interact often is more helpful in understanding the observed performance. Conceptual analysis of a polarization situation usually can be greatly simplified by considering it in terms of the circularly polarized components involved. The utility of this approach is illustrated in a discussion of variously polarized waves, and the use of circularly-bipolarized antennas for controlled polarization diversity. The concept of intrinsic polarization is introduced to simplify situations involving relative rotation of source and receiving antenna. Methods are discussed for measuring the polarization characteristics of antennas in terms of the sense, axial ratio, and orientation of the radiated wave. Various types of polarization resolvers and polarimeters used for this purpose are described. Author (TAB)

N67-25061*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE PROGRAMS SUMMARY NO. 37-44, VOLUME III FOR THE PERIOD JANUARY 1, 1967 TO FEBRUARY 28, 1967. THE DEEP SPACE NETWORK
31 Mar. 1967 132 p refs
(Contract NAS7-100)
(NASA-CR-83741; JPL-SPS-37-44, Vol. III) CFSTI: HC $3.00/MF $0.65 CSCL 09F

CONTENTS:

1. TRACKING AND NAVIGATIONAL ACCURACY ANALYSIS p 3-62 refs (See N67-25062 12-07)
2. COMMUNICATIONS RESEARCH AND DEVELOPMENT p 63-105 refs (See N67-25063 12-07)
3. COMMUNICATIONS DEVELOPMENT ENGINEERING p 107-111 (See N67-20564 12-07)
4. FACILITY ENGINEERING AND OPERATIONS p 112-127 (See N67-25065 12-11)
5. OPERATIONS PROGRAMMING p 128-131 refs (See N67-25066 12-30)

N67-25062*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
TRACKING AND NAVIGATIONAL ACCURACY ANALYSIS
In its Space Programs Sum. No. 37-44, Vol. III 31 Mar. 1967 p 3-62 refs (See N67-25061 12-07)

Individual reports are presented on research connected with the deep space network accuracy and related experimental determinations and support activities. Among the topics covered are: navigational accuracy during planetary encounter; Doppler-ranging calibration and trajectory operations for the lunar orbiter; orbit determination, calculation and error analysis, and station location, for the Pioneer VII lunar occultation experiment; and mathematical and flight project support, and residual analysis program. N.E.N.

N67-25063*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
COMMUNICATIONS RESEARCH AND DEVELOPMENT
In its Space Programs Sum. No. 37-44, Vol. III 31 Mar. 1967 p 63-105 refs (See N67-25061 12-07)

Summaries of research on calibration techniques, antenna systems, frequency generation and control, and low noise receivers for the deep space network are presented. A step-recovery diode x6 frequency multiplier for the frequency synthesizer section, Side III of the Mariner Venus 67 precision ranging system is described. The design of a traveling wave maser for operation in the microwave frequency range is reported. Improved calibration techniques are discussed for X-band noise temperature; daily system RF noise temperature, and S-band rotary vane attenuator. Details are given on X-band gain measurements and gain measurements using Surveyor I signals for the advanced efficient antenna systems. N.E.N.

N67-25064*# Jet Propulsion Lab., Calif. Inst. of Tech., Calif.
COMMUNICATIONS DEVELOPMENT ENGINEERING
In its Space Programs Sum. No. 37-44, Vol. III 31 Mar. 1967 p 107–111 (See N67-25061 12-07)

In support of the deep space network, a study was made of the Az–El antenna structure deformations from gravity loads, and contour maps of deformations are presented. Structural changes mentioned are the removal of the counterweight and the ties between the reflector structure, and the addition of a few reinforcing bars. It is also stated that improvement in the reliability of the atomic hydrogen maser is anticipated by replacing all vacuum tubes with solid state devices. N.E.N.

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N67-23619# RAND Corp., Santa Monica, Calif.
THE APPLICATION OF ON-LINE GRAPHICAL TECHNIQUES FOR PROGRAMMING AND OPERATING A MOVING NETWORK MONITORING DISPLAY
L. Chester and R. Turn Jan. 1967 95 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(RM-5183-PR; AD-645483) CFSTI: HC $3.00/MF $0.65

The report describes the structure and operating procedures of experimental computer programs used to simulate a real-time moving network display of spacecraft checkout operations. Proposed in RM-4678-NASA (N65-35577) for use by the human monitor of an automated prelaunch checkout, the system dynamically shows, in network form, the successive and concurrent stages of a complex process. The programs were written in MAP for the IBM 7040/7044 computer system to be used with the RAND Graphic Input Tablet and a cathode ray tube display screen. The Tablet is used for on-line construction of the initial network and for operation of the simulation programs. (A complete program listing is available on request.) Author (TAB)

N67-23645*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
FLIGHT COMPUTERS AND SEQUENCERS
Narsingh Deo *In its* Supporting Res. and Advanced Develop. 28 Feb. 1967 p 59–61 refs (See N67-23641 12-11)

Redundancy optimization for space computers is discussed, including even and partial redundancy methods. Theorems are presented for the probability of system failure, reduction of failure by increasing redundancy, and increasing probability of failure by adding an extra module. M.W.R.

N67-23725# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.
ABACUS-II (GE-625 VERSION)
M. R. Edwards 31 Oct. 1966 137 p refs
(Contract AT(40-1)-2847)
(GEMP-447) CFSTI: HC $3.00/MF $0.65

A brief report verifying the conversion of ABACUS-II to Fortran IV for use on the GE-625 is presented. BNL-6562 contains a complete documentation of this code in Fortran II. Author (NSA)

N67-23782# Naval Ordnance Lab., Corona, Calif.
CODER COMPONENTS PROGRAM. HIGH-SPEED ANALOG MULTIPLIER
R. L. King and R. L. Conger *In its* Foundational Res. Proj. 1 Dec. 1966 p 1–5 *ref* (See N67-23781 12-23)

A nonlinear multipling circuit is being developed with the capability of taking the absolute value of one variable and multiplying it by another variable. The high speed multiplier uses photo-multiplier tubes, with argon and neon tubes used for the light source. The spectrum of light from these tubes is almost independent of the input power, and no continuous glow is produced when an alternating potential is applied to the tube. The photomultiplier produces a current, approximately proportional to the applied voltage squared, over a considerable voltage range. M.G.J.

N67-23825# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATIONS OF A MODEL READER ON A COMPUTER, PART II
V. P. Romanov 27 Sep. 1966 13 p refs Transl. into ENGLISH from Nauchno-Tekn. Inform. (USSR), no. 7, 1964 p 26–29
(FTD-HT-66-512; AD-644053) CFSTI: HC $3.00/MF $0.65

The article describes a model of an optimal system for automatic reading consisting of several blocks. The images of distinguishable symbols are treated by a two-dimensional filter to suppress noises, centered and compared with standards. Then, recognition occurs based on the minimum of the mean square deviation. Author (TAB)

N67-23852# University of Southern Calif., Los Angeles.
HYBRID AND DIGITAL COMPUTATION
R. B. McGhee and R. B. Walford *In its* [Solid State, Appl. Electromagnetics and Plasmas, and Inform. Sci.] 30 Sep. 1966 p 174–177 refs (See N67-23841 12-26)

The following studies were performed: (1) Reentry Tracking of Ballistic Vehicles by Hybrid Computation—program for reentry system parameter estimation by nonlinear regression; (2) Identification of Nonlinear Dynamic Systems by Hybrid Analog-Digital Computation—Bayesian identification scheme for solution on a hybrid computer; and (3) Algorithm for Fourier Transform Computations—program for carrying out algorithm for fast computation of Fourier transforms. G.G.

N67-23863# RAND Corp., Santa Monica, Calif.
JOSS: INTRODUCTION TO THE SYSTEM IMPLEMENTATION
G. E. Bryan Nov. 1966 21 p Presented at the Fall Symp. of DECUS, Lawrence Radiation Lab., Berkeley, Calif., 4–5 Nov. 1966
(P-3486; AD-644339)

JOSS is a time-shared computer system that provides for the solution of numerical problems via an easily learned language at remote typewriter consoles. The PDP-6 hardware used to implement JOSS consists of 32,000 words of 1.75m sec core memory, a 1-million-word 4m sec drum, a 6-million-word discfile, and various peripheral devices. A special data relocation mode for memory references has been added to facilitate interpretation of JOSS programs. The JOSS consoles, built around a Selectric I/O typewriter, were specially manufactured to RAND specifications. Features include full duplex signaling, line parity checking, a page eject mechanism, and several buttons and lights to control and report console status. The stand-alone JOSS software consists of the JOSS language interpreter and its arithmetic subroutines, a monitor for user scheduling and resource allocation, and I/O routines for the disc, drum, consoles, and other peripheral devices. JOSS service is currently available to nearly 500 users through 34 consoles, six of which are remote to RAND operating over both private and dataphone lines. Author (TAB)

N67-23952*# Stanford Research Inst., Menlo Park, Calif.
TECHNIQUES FOR THE REALIZATION OF ULTRA-RELIABLE SPACEBORNE COMPUTERS Final Report

Jacob Goldberg, Karl N. Levitt, and Robert A. Short Sep. 1966 397 p refs
(Contract NAS12-33)
(NASA-CR-80019) CFSTI: HC$3.00/MF$0.65 CSCL 09B

The state of the art of redundancy techniques for fault detecting and fault masking is assessed. Emphasis is on multiple line voting redundancy, error correcting codes, and redundant-state schemes for sequential networks. New techniques and improvment of existing techniques are proposed. Significant potential improvements in reliability are available in designs allowing for a high degree of reconfigurability in structure and programs, and system schemes and design techniques for such behavior are investigated. Discussed are minimal test schedules for fault detection, the design of highly modular processing networks and of programmable interconnection networks, and organization of maintenance and computation functions in a computer system. Error control for memory systems and for power supplies is considered, and the use of all-magnetic logic networks is examined. Included is a survey of the literature relevant to the attainment of reliable systems and networks through the use of redundant structures. K.W.

N67-23971*# National Aeronautics and Space Administration Goddard Space Flight Center, Greenbelt, Md.
COMPUTING THE PSEUDO-INVERSE
Christopher R. Herron Nov. 1966 21 p refs
(NASA-TM-X-55757; X-643-66-533) CFSTI: HC $3.00/MF $0.65 CSCL 09B

An orthogonalization algorithm for producing the pseudo–inverse of a matrix is described, and a Fortran program which realizes the algorithm is given in detail. Author

N67-24042# Dodge (F. W.) Co., New York.
SOVIET PROGRESS IN COMPUTER SCIENCES AND AUTOMATION
Jun. 1966 15 p refs
(Contract AF 33(657)-14782)
(MHR-66-63; AD-645835) CFSTI: HC$3.00/MF$0.65

From the variational principle equations are derived for the bending of elastic plates, consisting of alternating rigid and soft layers, and corresponding natural boundary conditions. Specific cases are investigated. Various variants are evaluated for the selection of sought functions and corresponding to them, variants of basic equations. Pointed out are the possibilities of formulating exact solutions in the case of laminated plates with regular structure. As an example, a solution is given of the problem of bending a regular multilayer plate, rectangular in plan. The explained results may be considered as a generalization of the bending theory of triple layer plates with soft filler. Author (TAB)

N67-24047# RAND Corp., Santa Monica, Calif.
COMPUTERS AND OUR FUTURE
M. E. Maron Dec. 1966 11 p
(P-3501; AD-644960) CFSTI: HC$3.00/MF$0.65

The following questions are discussed: What will be the impact of computing machines on our society 10, 20, 40 years from now; How will the expanding use of computers change the structure of society and our individual lives; What can be done to analyze and extrapolate into the future so as to predict the future impact of computing machines; What can be done toward evaluating the social and moral implications wrought by the computer; What actions might be taken to modify and alter some of the possible consequences. TAB

N67-24282 Weapons Research Establishment, Salisbury (Australia).
THE PARAMETER ESTIMATION PROBLEM IN MATHEMATICAL MODELLING
J. S. Allison Nov. 1966 81 p refs
(WRE-SAD-41) CFSTI: $3.00

The method of least squares is applied to the problem of estimation of parameters of a physical system using input–output records obtained from the system when in operation. This is done by forcing a mathematical model of the system with the measured input and adjusting model parameters so as to minimize the mean squared difference between the measured and the model outputs. It is shown that for this method to be applicable certain necessary and sufficient conditions must be satisfied, although failure to meet these conditions usually lies not with the method but with the manner in which the problem is cast. Two different methods for minimizing the mean squared error are described and some comparisons made between them with the aid of specially designed experiments. In addition, it is shown that one of the techniques, derived from classical sensitivity analysis, is identical in principle with another widely used technique, the method of quasilinearization. Finally, some consideration is given to the problem of assessing the accuracy of parameter estimates. Author

N67-24361# Federal Electric Corp., Paramus, N. J.
SYSTEMS ANALYSIS PROCEDURES FOR ADP APPLICATION OF THE CORRECTIVE MAINTENANCE BURDEN PREDICTION PROCEDURES. VOLUME II: SYSTEMS ANALYSIS PROCEDURES
T. J. Dickerson, S. T. Smith, J. V. Mathis, and C. Butler Jun. 1966 63 p
(Contract Nonr-3821(00))
(PTB-66-8; AD-644912) CFSTI: HC$3.00/MF$0.65

This volume contains the System Analysis Procedure, including a review of the mathematical model, detailed system flow charts, coding formats and table allocations that are necessary for programming the CMB Prediction Procedure for Automatic Data Processing. The materials presented are the results of the Phase IV effort under the Corrective Maintenance Burden Prediction Procedure development program. The complete study report is presented in Volume I of this report. The System Flow Charts and supporting data are presented in sufficient detail to permit an experienced systems analyst to write a complete program for the ADP application of the prediction procedures, but still presented in the degree of generalization necessary to permit the use of any of a number of the currently used, high-speed computer. Author (TAB)

N67-24402# Cornell Univ., Ithaca, N. Y.
A COMPUTER PROGRAM FOR SIMULATION OF PERCEPTRONS AND SIMILAR NEURAL NETWORKS: USERS' MANUAL
Trevor H. Barker 14 Jul. 1966 332 p
(Contract Nonr-401(40); Grant NSF GK-250)
(Rept.-8; AD-647611) CFSTI: HC$3.00/MF$0.65

The purpose of the report is to describe the capabilities of, and give instructions for the use of, a very general program designed for the simulation of perceptrons and perceptron-like networks. The program was written for the IBM 7090/7094. TAB

N67-24415# Philco Corp., Blue Bell, Pa.
R & D OF THE TECHNOLOGIES REQUIRED TO DESIGN AND FABRICATE ULTRAHIGH SPEED COMPUTER SYSTEMS Interim Report, 1 Jul.–30 Sep. 1966
30 Sep. 1966 18 p
(Contract AF 19(628)-5167)
(IR-9; ESD-TR-67-44; AD-647751) CFSTI: HC $3.00/MF $0.65

A description is given of the first three months of the research and development program. The main program effort is concentrated on the investigation of the technological problems involved in the design, fabrication and testing of various forms of small-geometry, high-speed, complex bipolar arrays. The first

functional 3-bit parity arrays were fabricated and fabrication of 9-bit arrays was begun. The composite drawings for a 27-bit parity array were completed. Evaluation of the SMX4 ECL microcircuit gate continued as part of the investigation of factors which determine the performance and yield of simple high-speed microcircuits. Author (TAB)

N67-24576# Brookhaven National Lab., Upton, N. Y.
DATA EDITING AND PROCESSING COMPUTER PROGRAM FOR ULTRACENTRIFUGE MOVING BOUNDARY SCHLIEREN PATTERN CALCULATIONS
Rodes Trautman Jun. 1966 133 p refs
(Contract AT(30-2)-GEN-16)
(BNL-990(T-420)) CFSTI: HC $3.00/MF $0.65

Data editing and processing for Schlieren optical moving boundary ultracentrifugation using a Fortran IV computer program are described. The program requires a 32K memory, all-purpose digital computer and can presently process two-dimensional comparator data for sedimentation rate and concentration determination as well as perform least squares polynomial curve fitting of any data. Instructions for input, generalized formulas, main program, and subroutines are discussed. NSA

N67-24660# Mitre Corp., Bedford, Mass.
USERS' MANUAL FOR THE EDITOR
Bed Isquith Nov. 1966 83 p
(Contract AF 19(628)-5165)
(MTR-222; ESD-TR-66-309; AD-646717) CFSTI: HC $3.00/MF $0.65

EDITOR I is an on-line program within the initial PHOENIX computer software system which enables the system user to create, destroy, or modify his collection of symbolic data, organized as files. The actions of EDITOR I are user-controlled by means of a one-pass assembler. Author (TAB)

N67-24685# Oak Ridge National Lab., Tenn.
PROPOSAL TO ACQUIRE A DATA-HANDLING SYSTEM FOR THE OAK RIDGE ELECTRON LINEAR ACCELERATOR
W. R. Burrus, J. A. Harvey, F. C. Maienschein, J. W. Reynolds, and J. G. Sullivan 17 Jan. 1967 29 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1746) CFSTI: HC $3.00/MF $0.65

This proposal outlines the computer system and associated digital equipment planned for data handling at the Oak Ridge Electron Linear Accelerator (ORELA). In order that ORELA fulfill its experimental objectives, including that of being a major source of neutron cross-section information for the fast breeder reactor program, the data-handling system is essential for the high data-accumulation rates and masses of data to be analyzed. The system is divided into three distinct parts corresponding to stages of data handling: acquisition, immediate analysis, and final analysis. Justification is given for this division and alternate systems are considered. The system is to be delivered in three parts. The first part is expected in February 1968, three months prior to completion of the acceptance tests of the accelerator; the second part is to be delivered in February 1969; the third part is to be delivered in February 1970. A portion of the system will be shared with the other large ORNL nuclear physics facilities (the Isochronous Cyclotron and High Voltage Laboratory). Author (NSA)

N67-24734# Air Force Cambridge Research Labs., Bedford, Mass. Data Sciences Lab.
A PROGRAM FOR TRANSFORMATIONAL SYNTACTIC ANALYSIS
Stanley R. Petrick Oct. 1966 13 p refs *Its* Phys. Sci. Res. Papers, No. 278
(AFCRL-66-698; AD-646973) CFSTI: HC $3.00/MF $0.65

The paper defines a class of transformational grammars and describes the operational characteristics of a program for the analysis of sentences with respect to an arbitrary member of this class of grammars. The program in question exists both in pure LISP form and mixed LISP and IBM 7090 assembly language form. The latter is, of course, applicable only to the IBM 7090 computer, but the pure LISP program can be run on any computer with a LISP system. This program has been tested on the IBM 7044 and 7090 computers and the UNIVAC M-460 computer, and a special version has been provided for the MIT compatible time-sharing system. The paper contains the necessary information to enable a user to write his own transformational grammar and determine whether it assigns structural descriptions as intended. Computer program operating details and formats are included. These are illustrated by the analysis of several sentences with respect to a sample grammar. Typical operating performance is discussed, but a complete description of the analysis algorithm used by the program is not included. Author (TAB)

N67-24741# Naval Air Development Center, Johnsville, Pa.
INVESTIGATION OF ENCODERS EMPLOYED FOR ALTITUDE REPORTING Final Report
John P. McHale 18 Jan. 1967 25 p refs
(NADC-AM-6672; AD-647061) CFSTI: HC $3.00/MF $0.65

The results of a limited laboratory investigation of shaft encoders intended for use in automatic altitude reporting are included in this report. Some recommendations for inclusion in an encoder specification are also submitted. Author (TAB)

N67-24744# Naval Weapons Lab., Dahlgren, Va.
THE FLAP LANGUAGE—A PROGRAMMER'S GUIDE
Alfred H. Morris, Jr. Jan. 1967 54 p refs
(K-8/67; AD-647549) CFSTI: HC $3.00/MF $0.65

The guide is a presentation of the capabilities and operations of the language FLAP, a language written for the IBM 7090 that allows an analyst to handle symbolic mathematical data in a variety of ways. Examples involving polynomials, vectors, and matrices, as well as other forms of data, are given to illustrate how the language can be employed. Author (TAB)

N67-24807# Columbia Univ., Dobbs Ferry, N. Y. Hudson Labs.
HARDWARE DOCUMENTATION OF A 127-BUTTON ACCESSORY KEYBOARD Technical Report
Charles Amann and Melvin Klerer Oct. 1966 46 p refs
(Contract Nonr-266(84))
(CU-151-66-ONR-266-Phys; TR-126; AD-646763) CFSTI: HC $3.00/MF $0.65

The Accessory Keyboard is a general, low-speed, experimental unit for an automatic programming system. The system permits mathematical symbols and phrases to be automatically typed on a Flexowriter. It has 127 coded push-button inputs corresponding to 127 optional phrases, symbols, or programs. Author (TAB)

N67-24818# Naval Research Lab., Washington, D. C.
UPDATE: A UTILITY PROGRAM FOR THE AN/GYK-3(V) MODULAR DATA PROCESSING SYSTEM
Robert M. Cameron 4 Jan. 1967 17 p refs
(NRL-MEMO-1738; AD-646798) CFSTI: HC $3.00/MF $0.65

UPDATE was written as an interim solution to the basic problem all data processing systems face in a real time environment: total loss of all unprocessed data during error-induced diagnostic recovery modes. It provides the user with a means of periodically updating the permanent drum copy of any data object from its core image, thus allowing a return from diagnostics to an operational environment with a minimal loss of data. UPDATE is part of the Automatic Operating and Scheduling Programs (AOSP) repertory of service and utility routines for the AN/GYK-3(V) (Burroughs

D-825) computer, and is available for use by all operational programs. The report includes operating instructions, a detailed description of the program, a Neliac source listing, an octal dump of the object tape, and a generalized flow chart indicating the sequence of events during the execution of the program. Author (TAB)

N67-24822# IIT Research Inst., Chicago, Ill. Computer Sciences Div.

DIALOG: A CONVERSATIONAL PROGRAMMING SYSTEM WITH A GRAPHICAL ORIENTATION

Scott H. Cameron, Duncan Ewing and Michael Liveright Sep. 1966 50 p refs

(TN-109; AD-646857) CFSTI: HC $3.00/MF $0.65

DIALOG is an algebraic language for on-line use with a graphical input-output console device. It is a computational aid for the casual user, which provides basic facilities for graphical and numeric input and display, on and off-line program preparation and storage, and hard copy presentation of results. Use of the system requires a minimum of experience or instruction, since the growth of an overlaying system control language has been prevented, and there are no processor-oriented statements, like variable type or dimension declarations. Moreover, in the on-line situation, the processor interacts with the graphical keyboard on a character by character basis so as to restrict the programmers choice of input symbols to those which are syntactically correct. DIALOG has been in daily operation at the IIT Research Institute since February, 1966. Author (TAB)

N67-24846# Rome Air Development Center, Griffiss AFB, N. Y. Research and Technology Div.

DESIGN OF A PROGRAM LINKAGE AND COMMUNICATION MECHANISM FOR THE GE 645 COMPUTER SYSTEM Final Report

Edward Morenoff and John B. McLean Jan. 1967 41 p refs

(RADC-TR-66-726; AD-647258) CFSTI: HC $3.00/MF $0.65

A generic technique for effecting both intra-computer and inter-computer program communications is briefly summarized. The design specification for the implementation of this technique on the GE-645 computer system is described. The structure and organization of the hardware mechanism through which the programs are linked and the necessary support software to facilitate its use are both considered. The basic feature of the technique is the insertion of a Buffer File into each data flow path from one program to another. A Buffer File Control Word containing control and state information is associated with each Buffer File. The hardware mechanism provides a capability for simultaneously manipulating up to eight Buffer File Control Words, symbolically referencing them in a program, and verifying and controlling a Buffer Files access rights. Author (TAB)

N67-24847# Naval Air Development Center, Johnsville, Pa. Aero-Electronic Technology Dept.

NONDESTRUCTIVE READOUT (NDRO) FROM THIN MAGNETIC FILMS Final Report

S. Greenberg and P. Oliveri 9 Jan. 1967 45 p refs

(NADC-AE-6640; AD-647247) CFSTI: HC $3.00/MF $0.65

Five solid state phenomena were considered for possible use in nondestructive readout (NDRO) from thin magnetic film memories. The phenomenon of magnetoresistance in magnetic films was chosen as the most promising, and studies were made of this effect. Experimental studies of the switching characteristics of configurations involving magnetic films and other devices, such as tunnel diodes, were also made. Several experimental NDRO random access memories were built to demonstrate the feasibility of using magnetoresistance. The advantages of these memories were low drive currents and good s/n ratio. A new technique for an associative memory was conceived, and an experimental model was built to demonstrate feasibility. Author (TAB)

N67-24878# Northwestern Univ., Evanston, Ill. Information-Processing and Control Systems Lab.

ON SHIFT-REGISTER REALIZATIONS OF SEQUENTIAL MACHINES

Chau Chang Su Jan. 1967 61 p refs

(Contract N00014-66-C0020-A03; Grant AF-AFOSR-98-65)

(TR-67-104; AD-646593) CFSTI: HC $3.00/MF $0.65

The problem of determining secondary state assignments for sequential machines such that the binary memory elements are connected in the form of shift registers is studied. Algorithm for finding such state assignments is developed. One or more code words may be assigned to a state of the sequential machines. The only restriction is that the realizations be unitary. A single shift-register realization of a sequential machine is unitary if and if all code words assigned to a state have the same first digit. In a multiple shift-register realization of a sequential machine, corresponding to each shift register, there exists a set system on the state set of the sequential machine. A multiple shift-register realization is unitary if each of the set system is a partition and if all code words assigned to a block of the partitions have the same first digit. With our technique, the unitary realizations consisting of the least number of shift registers can be found for any finite, deterministic, synchronous and reduced (minimal-state) sequential machine, each of whose states has a non-empty predecessor set. The algorithm is suitable for programming on digital computers. Author (TAB)

N67-24830# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.

THE STRUCTURE OF A LISP SYSTEM USING TWO-LEVEL STORAGE

Daniel G. Bobrow and Daniel L. Murphy 4 Nov. 1966 26 p refs

(Contract AF 19(628)-5065; ARPA Order 627)

(SR-6; AFCRL-66-774; AD-647601) CFSTI: HC $3.00/MF $0.65

In an ideal list-processing system there would be enough core memory to contain all the data and programs. The paper describes a number of techniques used to build a LISP system which utilizes a drum for its prinicpal storage medium, with a surprisingly low time-penalty for use of this slow storage device. The techniques include careful segmentation of system programs, allocation of virtual memory to allow address arithmetic for type determination, and a special algorithm for building reasonably linearized lists. A scheme is described for binding variables which is good in this environment and allows for complete compatibility between compiled and interpreted programs with no special declarations. Author (TAB)

N67-24942# Stanford Research Inst., Menlo Park, Calif.

A BRIEF SURVEY OF PREPROCESSING FOR PATTERN RECOGNITION Interim Report, Jul.–Oct. 1966

Peter E. Hart Griffiss AFB, N. Y., RADC, Jan. 1967 45 p refs

(Contract AF 30(602)-3945)

(RADC-TR-66-819; AD-647275) CFSTI: HC $3.00/MF $0.65

The report is a literature survey in which 35 papers treating the preprocessing problem in pattern recognition are summarized and reviewed. Papers of both an analytical and a practical nature are included and a bibliography of 97 entries is provided. Author (TAB)

N67-24957# Michigan Univ., Ann Arbor. Inst. of Science and Technology.

NONCONSERVATIVE PROBABILISTIC INFORMATION PROCESSING SYSTEMS Final Report, Sep. 1963–Apr. 1966

Ward Edwards Bedford, Mass., AFSC, Electron. Systems Div., Dec. 1966 95 p refs

(Contract AF 19(628)-2823)

(ESD-TR-66-404; AD-647092) CFSTI: HC $3.00/MF $0.65

The report is concerned with two large-scale simulation experiments on probabilistic information processing (PIP) systems. One, a very large and prolonged study of four systems, yielded the conclusion that PIP is indeed an efficient philosophy for information processing systems—at least twice as efficient as its next-best competitor, and four times as efficient as a representative of current processing techniques. The second PIP experiment was concerned with whether likelihood estimators in PIPs should be allowed to know the state of system opinion; the data confirm the suggestion that it might be undesirable. These experiments required the use of an on-line computer system. This comparison of PIP and its competitors clearly indicates that PIP is superior, but does not indicate how PIP compares with theoretically optimal performance since no objective model of the data-generating process was available. A smaller-scale laboratory experiment is reported that compares PIP with a posterior-odds estimation system (POP) in a task sufficiently complex to be difficult for subjects and yet allowing an objective standard of correct performance. PIP was far superior to POP. PIP and calculations of optimal performance were roughly comparable, with PIP sometimes more extreme than optimal performance and sometimes less extreme. Another small laboratory study, concerned with the development of a response mode in which subjects report on probabilities by making choices among bets, is reported. Its original purpose was to develop a response mode for one group in the first PIP experiment, but it proved to be considerably more important than that. Author (TAB)

N67-24968# Utah Research and Development Co., Inc., Salt Lake City.

THEORETICAL AND EXPERIMENTAL STUDY OF LOW-VELOCITY PENETRATION PHENOMENA Final Report, May 1964–Aug. 1966

Emerson T. Cannon and E. Paul Palmer Nov. 1966 152 p refs
(Contract DA-19-129-AMC-150(X); ARPA Order 267)
(AD-646457) CFSTI: HC $3.00/MF $0.65

A computer code was developed for solving impact problems. The code uses moving mass points which have all the field variables such as pressure, energy, and stress associated with the points. The fields and their gradients determine the forces on the masses and change as the points move. The code was tested in a one-dimensional problem where it was found to produce correct results. An investigation was carried out on equations of state for materials of interest in armor development. A summary of existing data is given. A simple equation is given for the shock compression of metals and other materials and a computer code is given for calculating adiabatic expansions from a shock-compressed state. A complete report is given on an experimental program to measure material properties. The emphasis in the work is on measuring the energy involved in large-scale deformation of materials. Measurements were made by crushing disks of the test material in testing machines and by ballistic impacts. Measurements were also made on rod-to-rod impacts and on impacts of steel balls on thin plates of the test materials. Ultimate strength of materials was measured by measuring maximum acceleration of a free surface in rod-to-rod impact. Author (TAB)

N67-24975# Planning Research Corp., Los Angeles, Calif. Information Systems Div.

USE OF AIR FORCE ADP EXPERIENCE TO ASSIST AIR FORCE ADP MANAGEMENT, PHASE II. VOLUME I: SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS Final Report, 16 Feb.–15 Dec. 1966

Alan J. Gradwohl, George S. Beckwith, Stanton H. Wong, and Wolford O. Wootan, Jr. Bedford, Mass., AFSC, Electron. Systems Div., Dec. 1966 30 p
(Contract AF 19(628)-5988)
(PRC-R-932, ESD-TR-66-671, Vol. I; AD-646867) CFSTI: HC $3.00/MF $0.65

Volume I of the three-volume final report summarizes Phase II of a three-phase project on the Use of Air Force ADP Experience to Assist Air Force ADP Management. The history of the project is traced and the objectives, findings, conclusions, and recommendations are summarized and tabulated. The conclusions are as follows: that sufficient data can be collected to permit macrodescription of an ADPS; relationships do exist between workload descriptors and costs; the information can be distilled and organized into an indexed ADP Experience Handbook; and, for Phase III, an Air Force ADP Management Information System is necessary, feasible, and cost effective. The implementation of Phase III is recommended. Author (TAB)

N67-24991# Planning Research Corp., Los Angeles, Calif. Information Systems Div.

AIR FORCE ADP EXPERIENCE HANDBOOK (PILOT VERSION) Final Report, 16 Feb.–15 Dec. 1966

George S. Beckwith et al Bedford, Mass., AFSC, Electron. Systems Div., Dec. 1966 208 p
(Contract AF 19(628)-5988)
(PRC-R-930; ESD-TR-66-673; AD-646863) CFSTI: HC $3.00/MF $0.65

The purpose of the pilot version is to acquaint Air Force personnel with the concept of using highly organized, summarized, and retrievable ADP experience in judging proposals for new automation. The pilot version of the handbook contains data collected after the fact from only 18 ADP systems, and hence the handbook has limited usefulness for actual evaluation of ADPS proposals. It does however, contain cost estimation equations and narrative experience that will be useful until the 200 system handbook can be produced. Experience relevant to a proposed ADPS is retrieved from the handbook via information extracted from the proposal. The extracted information consists of quantitative workload descriptors of the proposed ADPS (e.g., number of input data fields and number of output formats) and certain qualitative descriptors (e.g. centralized or decentralized operations and presence or absence of direct access storage). The quantitative workload descriptors are used with cost estimation iso-graphs in the handbook to predict costs, so that proposed cost factors (e.g., man-months of development effort and dollars per month of hardware cost for application production) may be compared with Air Force experience. Both quantitative and qualitative descriptors are used to retrieve relevant information form the 18 system descriptions found in the handbook. The retrieved experience will be used to check consistency and to uncover potential problems of the proposed ADPS that may be encountered during system development and operation. A primer on the use of this handbook applied to a hypothetical ADPS proposal is published separately as AD-646 866. Author (TAB)

N67-25072*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

SUMMARY OF THE FUNCTIONS AND CAPABILITIES OF THE STRUCTURAL ANALYSIS AND MATRIX INTERPRETIVE SYSTEM COMPUTER PROGRAM

T. E. Lang 1 Apr. 1967 25 p refs
(Contract NAS7-100)
(NASA-CR-83742; JPL-TR-32-1075) CFSTI: HC $3.00/MF $0.65
CSCL 09B

The functions and capabilities of a large capacity structural analysis and matrix interpretive system (SAMIS) digital computer program developed to analyze frame and shell-type structures are described. Included is a description of each subprogram function with associated time-performance capabilities defined, as established by program usage at a particular computer installation. Program development considerations given to modularization of the program for functionally-diverse applications and reduction of errors in program usage are outlined. Finally two brief sections are included on program extensions currently under development, and the participation of engineering personnel in solving structural problems with the SAMIS computer program. Author

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N67-23502 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MULTICHANNEL PHOTOMULTIPLIERS FOR THE REGISTRATION OF X-RAY RADIATION
L. I. Andreyeva and B. M. Stepanov *In its* Certain Questions in Exptl. Phys. 26 Jul. 1966 p 5–17 refs (See N67-23501 12-23)

Electron optics and electrical properties of multichannel photomultipliers are considered. The photomultipliers, for the recording X-radiation with broadband output, have a maximum output current of 7 amps depending upon input conditions, and a resolving time of 2.5×10^{-9} sec. Author

N67-23503 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LINEAR GATING CIRCUIT FOR PULSES OF ANY SIGN
M. N. Tsaregorodtsev *In its* Certain Questions in Exptl. Phys. 26 Jul. 1966 p 19–23 ref (See N67-23501 12-23)

A linear gating circuit for pulses of any sign with amplitudes ranging from 0.5 to 50-60 volts and output pulse rise times the order of 450-300 v/microsecond are described. This circuit is used for delayed counting and registration of pulses on the voltage carrier of an electron ray collector tube in a multichannel analyzer with fast memory. Author

N67-23618# Army Electronics Labs., Fort Monmouth, N. J.
THIN-FILM SHIELDING TECHNIQUE
Robert A. Weck Nov. 1966 44 p refs
(ECOM-2775; AD-645139) CFSTI: HC $3.00/MF $0.65

A test instrument and measurement technique was devised to study the electromagnetic shielding properties of vacuum-deposited thin metallic films for applications in microelectronic circuitry and equipments. The test procedure is described, design information for the construction of the test device is given, and a theoretical basis for its use is presented. Author (TAB)

N67-23651*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ELECTRONICS PARTS ENGINEERING
E. T. Klippenstein *In its* Supporting Res. and Advanced Develop. 28 Feb. 1967 p 143–144 (See N67-23641 12-11)

Identification of designs, materials, and processes used in the manufacturing of electronic parts is being studied to (1) provide a basis for assessing design and process changes, (2) appraise new parts, (3) increase understanding of design strengths and weaknesses, and (4) provide a reference for use in failure analyses. Data are being collected, and photographs and diagrams will be used to illustrate the results that are to be compiled into booklets. M.W.R.

N67-23668*# National Aeronautics and Space Administration, Washington, D. C.
NONDESTRUCTIVE TESTING TECHNIQUES FOR MULTILAYER PRINTED WIRING BOARDS
James F. Blanche *In its* Nondestructive Testing: Trends and Techniques 1967 p 1–13 (See N67-23667 12-15)

Axial transverse laminography and mutual coupling were found to be feasible nondestructive techniques for the inspection of multilayer printed circuit boards. Laminography is well suited for mass inspection, will detect flaws as small as 0.03 mm, and can distinguish conductor layers separated from adjacent layers by 0.10 mm. Laminography can be used for detecting gross internal defects as well as for screening the boards; and the laboratory model of the laminograph is being developed into practical hardware that will make use of optical and closed-circuit television techniques. A fluorescent screen will produce continuous scanning capable of making permanent records. Mutual coupling, which can be used in conjunction with laminography to detect extremely small gaps in the through-connections, is limited in application because it requires probing of each connection. As a result, four to six coils are being deposited on a single probe to simplify the probing operation, improve probe geometry, and reduce minimum gap angle than can be detected. M.W.R.

N67-23675*# National Aeronautics and Space Administration, Washington, D. C.
FAST SCAN INFRARED MICROSCOPE FOR IMPROVING MICROELECTRONIC DEVICE RELIABILITY
Leon C. Hamiter, Jr. *In its* Nondestructive Testing: Trends and Techniques 1967 p 99–111 (See N67-23667 12-15)

An overview is presented of infrared testing to determine thermal and electromechanical parameters affecting the reliability of microelectronic components that conventional equipment and methods cannot measure. The minute size of the semiconductor chips is noted, along with a list of semiconductor defects; and design is described for the fast scan infrared microscope that can determine such defects. Optics, scanning system, detector with cryogenic cooling, signal processing, and display system for the microscope are considered. A study is underway to determine the feasibility of using infrared to predict which transistors are likely to fail from secondary breakdown and where the breakdown will occur. M.W.R.

N67-23828# Naval Air Engineering Center, Philadelphia, Pa.
CUSHIONING SYSTEM FOR ELECTRICAL CONTACT BRUSH ASSEMBLY
E. J. Lion 7 Sep. 1966 10 p
(NAEC-AML-2502; AD-640579) CFSTI: HC $3.00/MF $0.65

It is concluded that the pack utilizing unicellular polyethylene foam will provide protection necessary to retain the required co-planar alignment of contact points in normal transportation environments. Since the current pack without barrier materials weighs 22 ounces and the proposed pack 15 ounces, a net reduction of 7 ounces would be reflected in cost reductions on transportation charges. TAB

N67-23865# Lewis (E.B.) Co., Inc., East Hartford, Conn.
PRODUCTION ENGINEERING MEASURE CRYSTAL UNIT CR(XM-56)/U Quarterly Report, 16 May–16 Aug. 1966
Thomas F. Davis 16 Aug. 1966 21 p
(Contract DA-36-039-AMC-06180(E))
(QR-2; AD-644158) CFSTI: HC $3.00/MF $0.65

Design data and fabrication technique for AT-cut quartz crystals, 70 and 80 MC/s fifth overtone for filter application is presented. An evaluation of crystal units with various plate backs vs. mode suppression for the 80 MC/s design is given. Author (TAB)

N67-23880# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TRANSISTORIZED VOLTAGE CONVERTERS
Yu. K. Zakharov 26 Jul. 1966 80 p refs Transl. into ENGLISH of the publ. "Preobrazovateli Napryazheniya NA Poluprovodnikovkh Triodakh" Moscow, Voyennogeizd. Min. Oborony SSSR, 1964 p 1–102
(FTD-MT-65-81; TT-67-60309; AD-644069) CFSTI: HC $3.00/MF $0.65

Contents: Circuits of transistorized d-c converters and principle of their operation; Practical circuits of transistorized voltage

converters and their electrical characteristics; Designing transistorized voltage converters; Adjustment of operating conditions of voltage converters and elimination of failures. TAB

N67-23885# Los Alamos Scientific Lab., N. Mex.
OPTIMIZATION OF A THERMIONIC DIODE
C. D. Sutherland and W. A. Ranken [1966] 9 p Presented at the Thermionic Conversion Spec. Conf., Houston
(Contract W-7405-ENG-36)
(LA-DC-8178; CONF-661116-3) CFSTI: HC$3.00/MF$0.65

Numerical solutions have been obtained for the system of first order differential equations resulting from a one-dimensional approximation to the equations representing electrical conduction and heat transport in a cylindrical thermionic diode. Power output and efficiency of a single thermionic diode are maximized with respect to emitter length, output voltage, and emitter support resistance for an emitter with a diameter of 1.2 cm, which is constrained to a maximum temperature of 2100°K. Experimentally determined current–voltage characteristics at constant cesium pressure are used to determine emission current density as a function of emitter temperature and voltage. On the basis of a simple relation for the mass of a radiation-cooled thermionic diode reactor system as a function of power output per unit area and efficiency it has been determined that optimum emitter length increases approximately 30% in going from a high-performance diode (25 W/cm^2 maximum power output at 2100°K) to a relatively low-performance diode (12 W/cm^2 maximum power output at 2100°K). Author (NSA)

N67-23962# Library of Congress, Washington, D.C. Aerospace Technology Div.
MICROWAVE ELEMENTS BASED ON AVALANCHE–TRANSIT DIODES
Stuart Hibben *In its* Foreign Sci. Bull., Vol. 3, No. 1 Jan. 1967 p 1–9 refs (See N67-23961 12-23)

Shortly after the Read diode was proposed, Soviet research was begun on avalanche–transit diode oscillators. Studies since 1960 have now yielded several operational devices in the centimeter and millimeter range. These devices are described, and data are presented on similar recent efforts in the United States. Author

N67-24018# Texas Instruments, Inc., Dallas. Semiconductor-Components Div.
INTEGRATED CIRCUITS FOR PORTABLE RADAR EQUIPMENT Quarterly Report, 1 Jun.–31 Aug. 1966
E. Clayton Teague Dec. 1966 43 p refs
(Contract DA-28-043-AMC-02029(E))
(TI-03-66-130; Rept.-2; QR-2; ECOM-02029-2; AD-645047) CFSTI: HC$3.00/MF$0.65

Experimental results, and a theoretical description for vapor etching GaAs with HCl in H2 and H2 + AsH3 gas mixtures, are presented. Optical microscopy and surface profile studies of various surfaces have been performed to relate the initial substrate surface to the resulting germanium growth surface. These surface studies were made for selective and non-selective etch and deposition processes. Author (TAB)

N67-24060# Naval Radiological Defense Lab., San Francisco, Calif.
A SEARCH FOR A FAST DECAY COMPONENT IN NaI(Tl)/AN EVALUATION OF THE RCA 8575 PHOTOMULTIPLIER TUBE
John P. Hurley, Victor L. Da Gragnano, and James M. Mathiesen 2 Nov. 1966 24 p refs
(USNRDL-TR-1099; AD-645103) CFSTI: HC$3.00/MF$0.65

The general performance of selected RCA 8575 photomultiplier tube-NaI(T1) scintillator combinations was examined. The measurements were made with NaI(T1) crystals packaged with both glass and quartz windows. The results of the study show that the 8575 is fast, quiet, and shows virtually no internal interaction effects. In addition it was found that the increased light transmission capabilities of the quartz window produced no measurable changes in the measured resolving times. Author (TAB)

N67-24197# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
DESIGN OF PHOTOMULTIPLIER CIRCUIT FOR WIDE BAND AND HIGH FREQUENCY RESPONSE
Emmanuel A. Valsamakis and Arthur L. Lind Aug. 1966 28 p refs
(RM-336) CFSTI: HC$3.00/MF$0.65

A photomultiplier circuit is developed for use in a spectroscopic investigation of a pulsed plasma device. A procedure is outlined for the design of the photomultiplier circuit which faithfully reproduces low intensity, fast rise time (17 nanoseconds) light signals. Author

N67-24200# Grumman Aircraft Engineering Corp., Bethpage, N.Y. Research Dept.
DEVELOPMENT OF A TRANSISTOR REGULATOR SYSTEM FOR FINE CURRENT CONTROL OF AN ARC JET
Richard C. Jenkins and Marc Hoff Feb. 1967 30 p refs
(RM-355) CFSTI: HC$3.00/MF$0.65

A transistorized current regulator has been built to smooth out fluctuations in test section flow properties in the arc jet, and to maintain set values of arc current for long periods of time. This regulation system has been found to eliminate disturbances that originate in the power supply and control system, but does not affect disturbances that originate in the arc. Probe data obtained in argon flows show that the flow properties in the test section are essentially constant with the regulator in operation. In nitrogen and air flows, the regulator can remove the power supply ripple but not the 10KHz voltage ripple that appears to be a characteristic of the nitrogen arc. Probe data obtained in nitrogen flows show that these 10 KHz disturbances appear as fluctuations in electron density and temperature in the test section, and that accurate measurements require the use of suitable filters that limit the data to time-averaged values. Author

N67-24496# Army Electronics Labs., Fort Monmouth, N. J. Electronic Components Lab.
LONG-TERM FREQUENCY STABILITY OF CRYSTAL OSCILLATORS
Edward Simon Dec. 1966 29 p refs
(ECOM-2787; AD-647742) CFSTI: HC$3.00/MF$0.65

The report describes frequency stability performance versus time on several types of moderate and precision quartz crystal oscillators over a period of several years. Many of the oscillators are older units intended for use in a controlled environment with no restrictions on size and power consumption; present-day standards used in modern Army equipment are also represented. All of the oscillators evaluated in this report were compared with the USAECOM Primary Frequency Standard. A description of the instrumentation used to obtain the frequency stability data is given and its accuracy is discussed. A specially performed test of starting and stopping two crystal oscillators is included and their warmup characteristics and ability to return to the original frequency are described. Author (TAB)

N67-24498# Radio Corp. of America, Somerville, N. J. Defense Electronic Products.
HIGH PERFORMANCE THIN FILMS FOR MICROCIRCUITS Quarterly Progress Report, 1 Jun.–31 Aug. 1966
Franz Huber, William Laznovsky, and Walter Witt Feb. 1967 25 p refs
(Contract DA-28-043-AMC-01230(E))
(ECOM-01230-6; QPR-6; Rept.-6; AD-647891) CFSTI: HC $3.00/MF$0.65

A new sputtering system was designed and built with a vertical arrangement of electrodes to permit deposition of metal films free from pin holes. A hexagonally shaped substrate holder, which rotates to six different positions, allows performance of five sputtering runs without breaking the vacuum. A sputtering rate as high as 1500 A/min was achieved. A number of thin film hafnium dioxide capacitors were fabricated onto silicon substrates. Three different approaches were tested: (1) Silicon substrates passivated with a thermally grown oxide are used without making electrical contact between the hafnium film and the silicon substrates. (2) Windows etched into the SiO2 layer established ohmic contact between the silicon substrate (P-type) and the hafnium film which is partically converted into dielectric hafnium dioxide. (3) Hafnium metal completely converted into oxide. In another series of experiments, metal oxide semiconductor transistors were fabricated and studied with anodically formed HfO2 used as the gate insulator. A surface state density, N sub ss, of 13 x 10 to the 11th power states/sq cm was determined by capacitance - voltage measurements. This performance is comparable to thermally grown SiO2. The main advantage in using HfO2 for gate insulators are the high dielectric constant and the good dielectric properties of anodically grown oxides. Author (TAB)

N67-24600 Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.

ELECTRONIC SERVICE–CIRCUIT DIAGRAMS AND CHARACTERISTICS OF STANDARD ELECTRONIC EQUIPMENTS E 131 TO E 140 [SERVIZIO ELETTRONICO–CATALOGO DELLE APPARECCHIATURE ELETTRONICHE STANDARDIZZATE DA E 131 A E 140]

20 Oct. 1966 61 p In ITALIAN; ENGLISH summary
(ISS-66/39)

This catalog is to give to the experimenter a short account of equipment available off the shelf. The catalog will be printed in many issues each containing the data of ten equipments, an index of all issues will be periodically printed. Owing to the essentially practical purpose of this catalog, every specific technical and scientific detail was omitted, bibliographic detail is added only in the case of some new circuits. Author

N67-24654# Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.

THIN FILM RC NETWORKS FOR SILICON INTEGRATED CIRCUITS Quarterly Report, 1 Aug.–1 Nov. 1966

Louis Terry Jan. 1967 49 p refs
(Contract DA-28-043-AMC-02212(E))
(J-24; QR-1; ECOM-02212-1; AD-647385) CFSTI: HC $3.00/MF $0.65

Areas of investigation covered were: (1) A compatible process for depositing and trimming cermet resistors to a target value of 5000 ohms per square plus or minus 5 percent with a yield of 60 percent (87 percent within plus or minus 10 percent) was demonstrated. (2) Evaluation of various flash evaporated metal-dielectric cermet mixtures for 25,000 ohms per square resistor films was initiated. (3) In preliminary experiments, resistor films of 300 and 2000 ohms per square were RF sputtered from large area sources of CrSi2 and mixture A of TaSi2, Cr3Si, and Al2O3. (4) Process of completely compatible thin film capacitors and RF sputtered SiO2 and Al2O3 is presently being completed. (5) Films of BN and Si3N4 were RF sputtered onto silicon wafers. The films were similar to SiO2 and Al2O3, respectively, in quality and dielectric constants. (6) Investigated properties of RF reactive sputtered Ta, Si, Al oxide films. Capacitors (2.3 pF/sq mil - 8 volts) were formed from the dielectrics. (7) RF sputtered SiO2 on wafers containing transistors may decrease beta. The beta degradation is not permanent and can be recovered by a mild wash-bake cleaning cycle. (8) A linear amplifier circuit has been designed and breadboarded for evaluation before proceeding to the integrated thin film resistors and capacitors. Author (TAB)

N67-24683# Paris Univ., Orsay (France). Laboratoire de l'Accelerateur Lineaire.

CONTINUOUS AMPLIFIERS WITH VERY HIGH INPUT RESISTANCE. USES IN MEASUREMENTS BY OPERATIONAL AMPLIFIERS [AMPLIFICATEURS CONTINUS A TRES GRANDE RESISTANCE D'ENTREE. UTILISES DANS LES AMPLIFICATEURS OPERATIONNELS DE MESURE]

Ph. Bernaudin Jun. 1966 142 p refs In FRENCH
(NP-16429) CFSTI: HC $3.00/MF $0.65

The operational principle and the equivalence scheme of beam current measurements were reported. The theory of measurements in integrated value and in instantaneous value and the conditions required for the continuous amplifier were derived. Some operational amplifiers of the classic type, that is, a group of instantaneous current meters whose continuous amplifiers use electrometer tubes and current integrators whose continuous amplifier contains a mechanical vibrating condenser, were described. The complete study of a continuous amplifier with high input resistance using the variable junction capacity of two diodes was presented. A study was made on the MOS field effect transistors and their applications in the area of continuous amplifiers. Author (NSA)

N67-24727# Bunker-Ramo Corp., Canoga Park, Calif. Defense Systems Div.

PLANAR COAXIAL INTERCONNECTION TECHNIQUES Quarterly Report, 1 Jul.–30 Sep. 1966

Howard L. Parks, William Griff, and Robert B. Older Dec. 1966 66 p
(Contract DA-28-043-AMC-02024(E))
(F-058; ECOM-02024-2; QR-2; AD-646369) CFSTI: HC $3.00/MF $0.65

A thorough survey of the dielectric material requirements was conducted with attention directed at the field of applicable plastics. Experiments were undertaken with fluorocarbons, such as Teflon FEP film with specially treated surfaces, and a variety of epoxide systems. The application of Teflon was limited as it would be necessary to leave a thin layer of dielectric between the mating lands of the interlayer systems. The use of epoxy materials proved more flexible in their application to coaxial units. Methods for providing an epoxy to the required dielectric areas and their removal from connecting land areas were achieved. The combination of epoxide systems with various modifiers, flexibilizers, and other types of additives served to improve their functional characteristics. A series of experiments was performed to provide center-line conductors for the coaxial systems. The conductor lines were provided on both Teflon and epoxy substrates. Two techniques were utilized, including the foil lamination method and chemical deposition techniques. Control of line definition was more feasible on epoxy substrates. A time-and-method study favored the foil lamination technique on epoxy base materials. The efforts during this quarterly period indicate the feasibility for an epoxide dielectric barrier with a laminated foil method for accomplishing the coaxial conductor system. TAB

N67-24737# Naval Air Development Center, Johnsville, Pa. Aero-Electronic Technology Dept.

TEST PROCEDURES FOR FORCED AIR COOLED EQUIPMENT

B. Plizak Jan. 1967 45 p refs
(NADC-AE-6637; AD-647150) CFSTI: HC $3.00/MF $0.65

A test procedure for temperature-altitude testing of forced air cooled equipment using conventional recirculating chambers is proposed. Test results showing performances of forced air cooled TACAN AN/ARN-52 (V) at various temperature-altitude conditions with and without cooling air is presented and discussed in relation to existing specifications MIL-E-5400 and MIL-T-5422. Author (TAB)

N67-24799# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.
QUARTZ CRYSTAL AGING EFFECTS Semiannual Report, 15 Feb.–15 Aug. 1966
Richard B. Belser and Walter H. Hicklin Nov. 1966 124 p refs
(Contract DA-36-039-AMC-02251(E))
(A-680-11; ECOM-02251-3; Rept.-11; AD-646737) CFSTI: HC $3.00/MF $0.65

An investigation was made to reduce the aging and increase the reliability of quartz resonators. Average aging rates of 81.9 to 500 kHz units at 85C ranged from 0.15 to 0.28 ppm/wk for a period of 4500 hours subsequent to an initial aging phase of > 60 days. Units having lolished edges performed less well than others having a state-of-the-art edge finish. The average aging of 123 3 MHz resonators at 85C was 1.7 pp10 to the 9th power/wk during 4500 hours. Aluminum plated units mounted in evacuated HC-27/U holders averaged 0.72 pp10 to the 9th power/wk versus 1.5 pp10 to the 9th power/wk for gold plated ones. The average Q values were 1.2 and 0.75 x 10 to the 6th power respectively. Annular-field excitation of plano-convex 5 MHz units reduced aging rates to 1/10 that of conventionally-plated control units and the Q was doubled. Frequency spectra suffered no degradation. X-ray topography indicated oscillation was confined to the central 3/16 in. diameter zone for plano-convex units but extended over the entire plane-parallel zone (0.340 in. diameter) of units with beveled edges. The annulus was external to the active zone in the case of the plano-convex units and their Q values were four times greater. Aging of 10 MHz resonators at 125C indicated container dependency; rates for units in T-5 1/2 holder were greater than for those in HC-27/U. Serious outgassing or higher initial pressures in the T-5 1/2 holder are indicated. Author (TAB)

N67-24813# George Washington Univ., Washington, D. C. Human Resources Research Office.
A DESCRIPTION AND ANALYTIC DISCUSSION OF TEN NEW CONCEPTS FOR ELECTRONICS MAINTENANCE
Edgar L. Shriver and Robert C. Trexler Dec. 1966 140 p refs
(Contract DA-44-188-ARO-2)
(HUMrro-TR-66-23; AD-647229) CFSTI: HC $3.00/MF $0.65

Ten new concepts of electronics maintenance are described and analyzed in this report. These concepts differ from the conventional approach in that they advocate an equipment analysis for troubleshooting be made once by experts, then transmitted to the repairman, with appropriate supporting data, to obviate the need for repeated analyses by maintenance personnel on the job. Evidence from experimental evaluations of some of the concepts indicates the potential for marked increases in proficiency and/or decreases in training time as compared to current practice. Comparative evaluation of these concepts should consider system-wide implications rather than any single index, such as reduced training time or cost of preparation of manuals. It would appear that some maintenance situtations would be best served by a combination of features from several of the new approaches; in other cases is is possible that one of the concepts is uniquely suited to the particular circuitry or equipment configuration. Author (TAB)

N67-24848# Rome Air Development Center, Griffiss AFB, N. Y. Research and Technology Div.
THE EFFECT ON NON-UNIFORM QUANTUM EFFICIENCY ON OPTICAL SYSTEM PERFORMANCE
Raymond P. Urtz, Jr. Jan. 1967 22 p refs
(RADC-TR-66-794; AD-647248) CFSTI: HC $3.00/MF $0.65

Results of laboratory experiments are presented which point out the inherent non-uniform response of photomultiplier tubes. The experimental results show the fluctuations in quantum efficiency as a function of the position of the light signal on the photocathode surface. The effect of this non-uniformity on the operation of optical systems is pointed out and the magnitude of the problem is demonstrated using an RADC amplitude scintillation monitoring system as an example. Finally, a corrective technique is described to minimize the signal fluctuations. Author (TAB)

N67-24867# General Electric Co., Syracuse, N. Y. Tube Dept.
HIGH-CURRENT-DENSITY CATHODE-RAY TUBE ELECTRON SOURCE Final Report, 1 Apr. 1964–31 May 1966
M. Gibbons, P. Oakes, and M. Slivka Ft. Monmouth, N. J., Army Electron. Command, Dec. 1966 174 p refs
(Contract DA-28-043-AMC-00021(E))
(ECOM-00021-F; Rept.-8; AD-647263) CFSTI: HC $3.00/MF $0.65

A preliminary life-test was conducted on a conventional-sized (0.359-inch diameter) cathode containing the tungstate cathode material which was to be principally investigated in the program. The results of the life-test show that the cathode system possesses substantial life-potential. The cathode operated in excess of 9000 hours at 980C while a continuous emission current density between four and five amperes per sq cm was drawn. These current densities were the maximum which could be safely drawn for the size of cathode tested, with respect to the dissipation capability of the anode used. A considerable part of the effort in the program centered around developing a suitable mechanical design for the UHR-CRT (ultra-high-resolution cathode-ray tube) cathode. A number of configurations were investigated and, either for mechanical or thermionic considerations, were abandoned in favor of improved designs. The basic types of assembly which were studied included an insert-type assembly, a cup-cone design, and, finally, a design employing a cap over the basic cup-cone configuration. Emission and life-tests in sealed-off, gettered planar diodes were the criteria first used to evaluate prospective cathode designs and processing techniques. These were followed, or were accompanied in parallel in some cases, by emission and life-tests in actual sealed-off cathode-ray tubes. Author (TAB)

N67-24940# Lehigh Univ., Bethlehem, Pa. Inst. of Research.
STUDY OF THE PROPERTIES OF VARIABLE CAPACITANCE: SEMICONDUCTORS DEVICES Final Technical Report
Daniel Leenov and Walter E. Dahlke 31 Oct. 1966 57 p refs
(Grant DA-AMC-28-043-65-G-13)
(AD-645299) CFSTI: HC $3.00/MF $0.65

Contents: PIN Characterization Studies-Frequency Division; Frequency Conversion by a P(+)-N-N(+) Structure Having a Varying Impurity Atom Concentration; Tunneling in MOS-Structures. TAB

N67-24945# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
METAL-OXIDE-SEMICONDUCTOR FIELD EFFECT TRANSISTORS IN DIGITAL CIRCUITS
G. Donald Wagner Dec. 1966 112 p refs
(Contract NOw-62-0604-c)
(TG-875; AD-646914) CFSTI: HC $3.00/MF $0.65

The metal-oxide-semiconductor field-effect transistor (Mos Fet) is evaluated for use in digital circuitry. The basic building block, the digital inverter, is described and analyzed for four types of loading. The loads considered are: resistor load, enhancement mode MOS Fet load, depletion mode MOS Fet load, and complementary MOS Fet Load. Characteristics such as load line characteristics, power dissipation, transfer characteristics, and transient performance are discussed and compared. Equations describing the characteristics of each circuit have been derived and verified experimentally. The results clearly indicate the superior electrical characteristics of the complementary circuits. A typical complementary MOS Flip-Flop capable of one MHz operation is illustrated. Author (TAB)

N67-24948# Navy Electronics Lab., San Diego, Calif.
PRACTICAL, TUNABLE, TWO-MESH BANDPASS FILTERS FOR HF APPLICATIONS
I. C. Olson 18 Nov. 1966 32 p refs
(NEL-1416; AD-647358) CFSTI: HC $3.00/MF $0.65

The following equations were derived to facilitate filter design: Q sub CKT as a function of insertion loss and Q sub SL; net rejection at 1.1 f sub o as a function of Q sub SL and insertion loss; Q sub SL as a function of Q sub CKT and the coefficient of coupling. Correlation between the equations and the characteristics of an actual filter was found to be excellent. Author (TAB)

N67-24992# Hamilton Standard Div., United Aircraft Corp., Broad Brook, Conn.
MICROBONDS FOR HYBRID MICROCIRCUITS Final Report, 1 Feb. 1964–30 Apr. 1966
A. R. Riben and S. L. Sherman Jan. 1967 237 p refs
(Contract DA-36-039-AMC-03742(E))
(HSER-3160; ECOM-03742-f; Rept.-9; AD-647464) CFSTI: HC $3.00/MF $0.65

The overall objective of the program was the development of reliable high yield processes for bonding fine wires of gold and aluminum to gold-chromium and aluminum films on various substrates such as alumina, sapphires, and oxidized silicon. Furthermore, techniques were to be developed and evaluated for fabricating Micro-Circuit Modules (MCM) stacks and joining standard flat-packs to multilayer circuit boards by means of resistance welding and for ultrasonically bonding of flip-chip transistors to gold-chromium films on as-fired alumina. Fine wire bonds of aluminum wire to aluminum films made by ultrasonic bonding were studied. Statistical analysis of the quality and reproducibility of these bonds is presented. Also, a summary of the results on the fine wire microbonds studied during the program is presented. The application of parallel gap welding to the fabrication of MCMs was demonstrated as a practical technique for prototype or limited production of MCMs. Welding of MCM stacks consisting of alumina, glazed alumina, BeO and sapphire wafers were studied. The parallel-gap welding of flat-packs to multilayer wiring boards having surface layers of gold-nickel plated copper, gold plated nickel and alnifer conductors were studied. Statistical comparisons of the quality and reproducibility of these bonds are presented. The evaluation of a limited study of the mechanical quality and performance of ultrasonically bonded flip-chips is presented. Author (TAB)

N67-25079# General Dynamics/Convair, San Diego, Calif.
DEVELOPMENT OF ELECTRONIC CIRCUIT FABRICATION TECHNIQUES
J. A. Vierhus Dec. 1966 19 p refs
(GDC-ERR-AN-958) CFSTI: HC $3.00/MF $0.65 CSCL 09A

The objective of this project was to investigate methods for fabricating miniaturized electronics devices, including circuit interconnections, device joining, and flat package sealing. Circuit interconnections were accomplished by soldering and thermal compression bonding. Laser and ultrasonic bonding methods were also performed. Integrated circuits were successfully bonded to thin films and flat packages, using a die bonder. Flat packages as small as 1/4 by 1/4 in. were satisfactorily sealed by applying a lid having germanium alloy deposited on one side. The lid was installed under programmed heat and pressure. Circuit interconnections by soldering and thermal compression bonding, as well as device attachment and flat package sealing could readily be advanced to production capability. Specific recommendations are made for continuing this project optimizing existing parameters, applying these techniques to circuit manufacture, and investigating existing and new methods and processes. Author

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N67-23540# California Univ., Los Angeles. Dept. of Engineering.
OPTIMAL CONTROL THEORY APPLIED TO SYSTEMS DESCRIBED BY PARTIAL DIFFERENTIAL EQUATIONS, VOLUME 1 Final Report
W. L. Brogan May 1966 231 p refs
(Contract DA-04-495-AMC-746(Z))
(Rept.-66-31; AD-646094) CFSTI: HC $3.00/MF $0.65

The study of optimal control problems for distributed parameter systems is intimately connected to the study of partial differential equations and/or integral equations involving two or more independent variables. The primary purpose of the dissertation is to investigate the application of optimal control theory to systems described by partial differential equations. The intent is not to advance the theory of partial differential equations per se. Thus all considerations will be restricted to the more familiar equations of the type which often occur in mathematical physics. Specifically, the distributed parameter systems under consideration are represented by a set of field equations. TAB

N67-23716*# Rensselaer Polytechnic Inst., Troy, N. Y.
SYSTEM IDENTIFICATION AND PATTERN RECOGNITION
Rob Roy and James Sherman Washington, NASA, Apr. 1967 31 p refs
(Grant NGR-33-018-014)
(NASA-CR-756) CFSTI: HC $3.00/MF $0.65 CSCL 09C

Described is a new method for system identification. Based upon the relaxation technique used in pattern recognition, the proposed method of identification produces the hypersurface of the input–output transformation. It is shown that the describing hypersurface is equivalent to a volterra series representation of the system and that the identification technique produces the kernels of the volterra representation. The relaxation (or error-correcting) technique will converge to the correct solution, even when the measurements are corrupted by noise. Any final error in the weight vectors (constants of the hypersurface) is shown to be bounded by a constant which is directly proportional to the variance of the measurement noise. In addition, experimental results have shown that the range of acceptable noise variance under which the system will converge can be greatly increased if the noise is correlated. Both theoretical and experimental results are presented to support these conclusions. Author

N67-23718*# Hughes Aircraft Co., Culver City, Calif.
STUDY OF DIODE-IRIS CONTROLLED WAVEGUIDE SLOT RADIATORS
B. J. Forman, J. Y. Wada, and W. H. Kummer Washington, NASA, Apr. 1967 46 p refs
(Contract NAS1-4053)
(NASA-CR-763) CFSTI: HC $3.00/MF $0.65 CSCL 09C

X-band studies concerned with positioning semiconductor diodes and plasma devices about a slot radiator to control the amplitude and phase of the slot radiation were continued. An iris cluster of four semiconductor varactor diodes was developed that produced 360 degrees of phase control at amplitude levels up to −14.5 db (relative to the incident power) and less phase control for amplitudes up to −7.8 db. The VSWR response never exceeded 1.55:1, and the nominal ohmic loss varied from 14.5 to 8.1 percent. Six-volt varactors operated satisfactorily at r-f power levels to 0.1 milliwatt while lossier, 40-volt versions functioned at 1.0 milliwatt. A five-element, traveling-wave, linear array containing 6-volt diode irises was designed, fabricated, and tested. Diode-iris control provided ±60 degrees of electronic beam scanning about

broadside. Feasibility studies with various gas discharge waveguide irises predicted an electron injection plasma varactor design capable of operation at substantial r-f power levels with a few watts drive power and very low ohmic loss. A four-plasma iris prototype displayed a 125-watt power handling capability and an average ohmic loss of 5 percent. This unit provided 360 degrees of slot phase control at coupling levels of −13 db and exhibited a VSWR variation below 1.73:1. Author

N67-23798*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE ANALYSIS AND CALIBRATION OF ANALOG TO DIGITAL ENCODERS
J. A. Loger Washington, NASA, May 1967 23 p refs
(NASA-TN-D-3913) CFSTI: HC $3.00/MF $0.65 CSCL 09F

The conversion of continuously varying data into a form acceptable to a digital telemetry system introduces error into the data. The errors in this signal conditioning process are examined, and expression for them are derived by using statistical methods. The standard calibration procedure for analog to digital encoders is examined and found to be inadequate. A method of calibration is presented which overcomes the inadequacies of existing procedures. Author

N67-23849# University of Southern Calif., Los Angeles.
CONTROL SYSTEMS
In its [Solid State, Appl. Electromagnetics and Plasmas, and Inform. Sci.] 30 Sep. 1966 p 129–154 ref (See N67-23841 12-23)

Work continued on: (1) *General Theory of Optimization*—mathematical programming problems and simplification of theory; (2) *Dynamic Programming, Invariant Imbedding, and Quasilinearization*—dynamic programming formalism for biomedical problems, and new numerical techniques for digital computer solutions; (3) *An Optimum Interception Control Rule*—proportional navigation was not optimal if expected miss distance was used as performance measure; (4) *Control of Distributed Parameter Systems*—application of known theoretical results to physical problems; (5) *Studies of Combined Modulation Control Systems*—sensitivity of combined pulse-width and pulse-amplitude modulated control systems; (6) *Manual Control Data Acquisition Facility*—construction of experimental station for studies on multiple input manual tracking control tasks for pilots; (7) *Pulse Models of Human Operators Performing Compensatory Tracking with Coordinated Multiple Inputs*—eye motion measurements on pilots during manual control task; (8) *Random Parameter Models of Human Controllers*—algorithm for estimating statistical properties of human operators; (9) *Finite-State Models of Manual Control Systems*—adaptation procedure in manual tracking; and (10) *Minimum Complexity Space Vehicle Attitude Control*—single-degree of freedom model development. G.G.

N67-23871# Sylvania Electric Products, Inc., Mountain View, Calif.
TIME RESPONSES AND PARAMETER ESTIMATION OF NONLINEAR CONTROL SYSTEMS
C. McMillan and E. Huber Jan. 1967 50 p refs
(Contract DA-28-043-AMC-01829(E))
(EDL-M954; ECOM-01829-M954; AD-645881)

Control systems that include nonlinear devices such as limiters and relays with hysteresis are described by a set of first-order nonlinear differential equations. A Runge-Kutta integration method with special procedures to recognize discontinuities is then used to determine time responses using a digital computer. Results are presented for a nontrivial attitude-control system. Initial attempts of estimating parameters for this system using iterative minimization procedures were only partially successful. The difficulties encountered are discussed. Author (TAB)

N67-23936# Bell Aerosystems Co., Buffalo, N. Y.
NONLINEAR PREPROCESSING OF INPUTS TO LINEAR NEURAL NETS
J. A. Goerner, L. A. Gerhardt, and F. D. Powell Oct. 1966 55 p refs
(Contract AF 49(638)-1627)
(Rept.-9500-920059; AFOSR-67-0054; AD-645499) CFSTI: HC $3.00/MF $0.65

Discrimination of analog signal patterns by linear single-gain layer nets can be significantly improved by feeding the analog signals into preprocessors that convert each analog signal to a binary signal with m bits, thus increasing the number of gain elements from n to nm. The number of input vectors to which an arbitrarily desired net output can be assigned increases correspondingly from n to mn. This result holds for any binary converter with word length m independent of the code of the converter. The number increases further with the radix q if a q-ary preprocessor is employed. The common quantizer shows particular merits for practical applications as only one output line in any quantizer is active, thus allowing gain adjustments independent of each other within each quantizer. The combination of quantizer and linear net is reported on in detail. With a forced learning-type training algorithm, final gain values are shown to represent the difference of the conditional probabilities of the input pattern classes. The combination of quantizer and linear net instruments a type of likelihood ratio. With an error-correcting training algorithm, the final gains form a gain vector such that the error with respect to the desired output for each class becomes minimized in the least mean square sense. Author (TAB)

N67-23939# Navy Electronics Lab., San Diego, Calif.
A BAYESIAN MODEL FOR TROUBLESHOOTING ELECTRONIC EQUIPMENT Research Report, Jan.–Jul. 1966
R. L. Hershman and M. Freitag 9 Nov. 1966 22 p refs
(NEL-1412; AD-645577) CFSTI: HC $3.00/MF $0.65

Bayes Theorem is applied to the problem of formulating an optimum strategy for the troubleshooting of equipment failures. The probabilities attaching to hypotheses about the various possible causes of system failure are modified according to the theorem, and the process of testing and replacing components is structured so as to minimize the expected total cost of system restoration. Author (TAB)

N67-23946 Joint Publications Research Service, Washington, D. C.
SOVIET RESEARCH IN AUTOMATION AND CYBERNETICS
13 Feb. 1967 70 p refs Transl. into ENGLISH from Avtomatyka (Kiev), v. 11, no. 5, 1966 p 3–4, 15–26, 28–36, 45–55, 90–94
(JPRS-39877; TT-67-30525) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. DISPERSION METHOD OF SPONTANEOUS SUBDIVISION OF THE IMAGE SPACE INTO COMPACT SETS (PATTERNS) V. S. Volokhov and Y. P. Zaychenko p 5–21 refs (See N67-23947 12-10)

2. INDETERMINATE PATTERN RECOGNITION SYSTEMS O. G. Ivakhnenko p 22–35 refs (See N67-23948 12-10)

3. EVALUATION OF OPERATION OF AN INFORMATION TRANSMISSION CHANNEL WITH PRIORITY E. Ya. Dorokhov p 36–44 refs (See N67-23949 12-07)

4. SIMULATION OF PURPOSEFUL BEHAVIOR OF LIVING ORGANISMS A. M. Kasatkin and L. M. Kasatkina p 45–52 refs (See N67-23950 12-10)

N67-23947 Joint Publications Research Service, Washington, D. C.
DISPERSION METHOD OF SPONTANEOUS SUBDIVISION OF THE IMAGE SPACE INTO COMPACT SETS (PATTERNS)

V. S. Volokhov and Yu. P. Zaychenko *In its* Soviet Res. in Automation and Cybernetics 13 Feb. 1967 p 5–21 refs (See N67-23946 12-10)

The problem of classifying the image space in patterns is defined. Linear and nonlinear transformation equations are given for changing the distance functions of the image space to obtain compactness of the images, followed by application of linear transformations to obtain optimum linear subdivision of two patterns (or classes). Methods for determining the distribution of image space in patterns by means of a vector with the largest eigenvalues are demonstrated for cases when the class of the image is unknown, i.e., self-teaching of recognition. Covariance matrices, successive approximations, and algorithms are used for analyzing sample distributions. K.W.

N67-23948 Joint Publications Research Service, Washington, D. C.

INDETERMINATE PATTERN RECOGNITION SYSTEMS

O. G. Ivakhnenko *In its* Soviet Res. in Automation and Cybernetics 13 Feb. 1967 p 22–35 refs (See N67-23946 12-10)

The applicability of automatic control theory to determinate and indeterminate processes is briefly reviewed, and specific propositions are developed for the use of a perceptron as a recognition system in cases of search for constant prototypes. A recognition system with indeterminate prototypes is compared with a system with averaged signals. The role of probability distribution in such systems is investigated. Briefly described are characteristics of adaptive search systems and of teaching model systems. K.W.

N67-23950 Joint Publications Research Service, Washington, D. C.

SIMULATION OF PURPOSEFUL BEHAVIOR LIVING ORGANISMS

A. M. Kasatkin and L. M. Kasatkina *In its* Soviet Res. in Automation and Cybernetics 13 Feb. 1967 p 45–52 refs (See N67-23946 12-10)

Discussed are the principles of a simulation method for complex systems, based on the application of grids of some formal elements. Each element of the grid is described by a set of specific means of associations characterized by certain coefficients of association. Structure and function of an automaton are described which uses the grid system for simulating information processing by the human brain and connects this with human behavior in situations of a certain class. The automaton makes decisions and carries them out after an "emotional" as well as a logical evaluation of information. The automaton functions in a set of cells, each of which may either be empty or contain one of the objects which stimulate the automaton. The operation of the automaton is cyclic, and it functions in discrete time. The character of the automaton's behavior may be changed, making it in turn bold, timid, trustful, or careful. Experiments were conducted with the automaton by simulating its operation on a computer. Results indicate potential usefulness for simulating human physical functions. K.W.

N67-23978# California Univ., Los Angeles. Dept. of Engineering.

THE OPTIMAL CONTROL OF LINEAR DISTRIBUTED PARAMETER SYSTEMS. CONTROL OF DISTRIBUTED PARAMETER SYSTEMS, VOLUME II Final Report

E. I. Axelband and R. Chattopadhyay May 1966 103 p refs (Contract DA-04-495-AMC-746-(Z))

(Rept.-66-32; AD-646095) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. THE OPTIMAL CONTROL OF LINEAR DISTRIBUTED PARAMETER SYSTEMS E. I. Axelband 46 p refs (See N67-23979 12-10)

2. CONTROL OF DISTRIBUTED PARAMETER SYSTEMS R. Chattopadhyay 46 p refs (See N67-23980 12-10)

N67-23979# California Univ., Los Angeles. Dept. of Engineering.

THE OPTIMAL CONTROL OF LINEAR DISTRIBUTED PARAMETER SYSTEMS

E. I. Axelband *In its* The Optimal Control of Linear Distributed Parameter Systems May 1966 46 p refs (See N67-23978 12-10)

Several optimal control problems for linear distributed parameter systems are stated, and theoretical and algorithmic solutions are presented along with examples to illustrate the results. Specialized notions and symbology not in common usage in optimal control theory are introduced, and the requisite mathematical operations are explained. Optimal control problems discussed include their use as a two point boundary value problem, and in systems with bounded outputs. The term distributed parameter system as used in this report means a plant or object whose outputs are controlled and characterized by a partial differential equation. L.S.

N67-23980# California Univ., Los Angeles. Dept. of Engineering.

CONTROL OF DISTRIBUTED PARAMETER SYSTEMS

R. Chattopadhyay *In its* The Optimal Control of Linear Distributed Parameter Systems May 1966 46 p refs (See N67-23978 12-10)

The stability of systems of partial differential equation are considered in mathematical models for optimal control of distributed parameter systems. Zubov's theorem and its applications are discussed, and Krasovskii's results are extended. Some important regions in state function space are analyzed. State variables for systems in both integral and in differential form are estimated. Mathematical techniques for identifying such systems, and adaptive control are described. General theory of optimal distributed parameter systems; and minimum energy optimal interception with boundary controls, are discussed. Also considered are basic concepts, measurement errors, and spectral analysis techniques for stochastic control systems. L.S.

N67-24091# Applied Radiation Corp., Walnut Creek, Calif.

PROPERTIES OF DISC-LOADED CYLINDRICAL WAVE GUIDE PROPAGATING THE TM-02 MODE

W. J. Gallagher *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 194–195 refs (See N67-24061 12-11)

Experimentally determined properties are presented of the TM-02 mode for the $2\pi/3$ longitudinal mode at the velocity of light, from which it would appear that this mode is significantly better for applications in accelerators with large output beam currents. NSA

N67-24201 Joint Publications Research Service, Washington, D. C.

TECHNICAL CYBERNETICS NO. 1, 1967

14 Apr. 1967 327 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Kibernetika (Moscow), No. 1, Jan.-Feb. 1967 p 1–192

(JPRS-40629; TT-67-31273) CFSTI: $3.00

Articles are presented on control and operations research problems, reliability and maintenance of complex systems, information processing and pattern recognition, and automatic control. For individual titles, see N67-24202 through N67-24227.

N67-24202 Joint Publications Research Service, Washington, D. C.

GENERALIZATION OF PONTRYAGIN'S PRINCIPLE OF THE MAXIMUM

R. L. Stratonovich *In its* Tech. Cybernetics No. 1, 1967 14 Apr. 1967 p 1–7 refs (See N67-24201 12-10)

It was shown that the principle of the maximum may be extended to the case of a variable control region depending on coordinates and time. Here, the variation in the dynamic variables is described not by the Pontryagin equations but by the Hamilton equations. An example of an harmonic oscillator with a rate restriction is investigated. Author

N67-24203 Joint Publications Research Service, Washington, D. C.

THE RELATIONSHIP OF THE BASIC THEOREMS OF MATHEMATICAL PROGRAMMING AND THE PRINCIPLE OF THE MAXIMUM

A. A. Pervozvanskiy *In its* Tech. Cybernetics No. 1, 1967 14 Apr. 1967 p 8–15 refs (See N67-24201 12-10)

The problem of definition of control of a discrete dynamic system achieving the optimal value of a linear function of finite values of the phase coordinates is investigated as the problem of mathematical programming. It is demonstrated that the principle of the maximum of Pontryagin for this problem is a direct consequence of the basic theorems of mathematical programming. The derivation of the conditions of optimalness similar to the principle of the maximum is given in the presence of restrictions imposed simultaneously on the controls and the phase coordinates. Author

N67-24204 Joint Publications Research Service, Washington, D. C.

THE INFLUENCE OF DISTURBANCES ON SCHEDULING

L. I. Feygin *In its* Tech. Cybernetics No. 1, 1967 14 Apr. 1967 p 16–21 refs (See N67-24201 12-10)

The process of scheduling error accumulation under the influence of disturbance effects is investigated. The necessary periodicity of correction in the scheduling is determined depending on the nature of the disturbances. Author

N67-24205 Joint Publications Research Service, Washington, D. C.

ANALYSIS OF THE PROBLEM OF AUTOMATIC OPTIMIZATION OF A LINEAR DIOPHANTINE OBJECT

L. Virag *In its* Tech. Cybernetics No. 1, 1967 14 Apr. 1967 p 22–31 refs (See N67-24201 12-10)

Mathematical analytical methods for problems involving automatic optimization of discrete objects, notably Linear Diophantine Objects (LDO's) are examined. Special features of the quality index of the LDO, and primary and secondary parameters of an LDO are discussed. Also considered are problems connected with calculation of LDO classifiers and denumerants. A technique to simplify the problem of automatic optimization of an LDO is described. L.S.

N67-24206 Joint Publications Research Service, Washington, D. C.

OPTIMAL DYNAMIC PRIORITIES IN SINGLE QUEUEING SYSTEMS

V. V. Rykov and E. Ye. Lembert *In its* Tech. Cybernetics No. 1, 1967 14 Apr. 1967 p 32–44 refs (See N67-24201 12-10)

A single queue system is investigated with N input flows of different types of demands. It is assumed that at the time of freeing of the device it is possible to send any of the demands in the queue for servicing (assume any of the N possible controls). The concept of dynamic priorities is introduced. The problem of determination of optimal dynamic priorities minimizing the average losses is stated. It is shown that in the class of systems with dynamic priorities the system with ordinary priorities is optimal (in the sense of minimization of losses). Author

N67-24207 Joint Publications Research Service, Washington, D. C.

EVALUATING THE RELIABILITY OF SYSTEMS WITH A VARIABLE UTILIZATION MODE

S. M. Brodi and O. N. Vlasenko *In its* Tech. Cybernetics No. 1, 1967 14 Apr. 1967 p 45–51 refs (See N67-24201 12-10)

A semimarkov process is constructed describing the functioning of systems operating in two periodically alternating modes. The reliability characteristics (the average time and probability of trouble-free operation) of such systems are defined. Author

N67-24208 Joint Publications Research Service, Washington, D. C.

RELIABILITY OF REPAIRABLE UNRESERVED MULTIACTION DEVICES

Yu. A. Slepov *In its* Tech. Cybernetics No. 1, 1967 14 Apr. 1967 p 52–56 ref (See N67-24201 12-10)

Expressions are derived for the definition of the preparedness function and the unconditional probability of trouble-free operation in the time interval $(t, t + \tau)$ for any law of distribution of the time of trouble-free operation and repair time. Some special cases of the expressions obtained are investigated. Author

N67-24209 Joint Publications Research Service, Washington, D. C.

OPTIMIZATION OF THE RELIABILITY OF A REDUNDANT SYSTEM

L. K. Isayev and N. A. Mamed-Zade *In its* Tech. Cybernetics No. 1, 1967 14 Apr. 1967 p 57–60 refs (See N67-24201 12-10)

A procedure is proposed for the solution of a problem with respect to determination of the maximum reliability of a reserved system with one restriction of the type of weight, cost or size. The proposed procedure is applicable for an increasing purpose function. Comparisons are made with other methods. Author

N67-24210 Joint Publications Research Service, Washington, D. C.

A PROBLEM IN OPTIMAL REDUNDANCY

O. G. Alekseyev *In its* Tech. Cybernetics No. 1, 1967 14 Apr. 1967 p 61–68 refs (See N67-24201 12-10)

The solution of the problem of optimal redundancy of an apparatus is investigated for several restrictions using the method of dynamic programming. For restriction of the search region, additional restrictions are introduced permitting significant decrease in the size of the computation operation and the requirements on the computer memory. Author

N67-24211 Joint Publications Research Service, Washington, D. C.

NUMERICAL CHARACTERISTICS OF THE PROBABILITY DISTRIBUTION FOR CORRECT OPERATION OF EMERGENCY SYSTEMS

V. V. Malev *In its* Tech. Cybernetics No. 1, 1967 14 Apr. 1967 p 69–79 refs (See N67-24201 12-10)

Expressions are presented for the average time and dispersion of the time of emergency-free operation for emergency systems consisting of an arbitrary number of single type operating and reserve devices with a Poisson distribution law for failures in various cases of organization of checking and repair of devices. Author

N67-24212 Joint Publications Research Service, Washington, D. C.

PREVENTIVE MAINTENANCE WITH RESPECT TO PROGNOSIS PARAMETER

I. B. Hertzbach *In its* Tech. Cybernetics No. 1, 1967 14 Apr. 1967 p 80–93 refs (See N67-24201 12-10)

A system is investigated with a parameter which varies randomly in time $\xi(t)$ the value of which at any point in time t determines the intensity of failure of the system $\lambda(\xi)$. For the parameter $\xi(t)$ called the prognosis parameter, some level is established with respect to the achievement of which necessary repairs of the system are made. The optimal level h is found which insures the maximum preparedness coefficient of the system. Cases are investigated where $\xi(t)$ is a Markov process with a finite number of states, a Poisson process and a linear process of the type of $\xi(t) = bt$. Author

N67-24213 Joint Publications Research Service, Washington, D. C.

MAINTENANCE OF COMPLEX TECHNICAL SYSTEMS, II

Ye. Yu. Barzilovich *In its* Tech. Cybernetics No. 1, 1967 14 Apr. 1967 p 94–114 refs (See N67-24201 12-10)

A brief survey of the basic works in the area of maintenance of a group of technical systems is offered. Some prospective methods of reliability control for complex systems are considered. Author

N67-24217 Joint Publications Research Service, Washington, D. C.

A PROCEDURE FOR SOLUTION OF THE PROBLEM OF RECOGNITION OF OBJECTS

R. I. Polonnikov and V. V. Aleksandrov *In its* Tech. Cybernetics No. 1, 1967 14 Apr. 1967 p 143–159 ref (See N67-24201 12-10)

A simple algorithm is proposed for studying pattern recognition as applied to parallel action classifiers. The algorithm includes operations for isolation of informative signs and making of a decision about classification by comparison of the code of the object to the standard model of some abstract subdivision into classes. The examples of application of the algorithm to recognition of different objects are investigated. Author

N67-24218 Joint Publications Research Service, Washington, D. C.

THE RELATIONSHIP OF DYNAMIC PROGRAMMING OF LYAPUNOV FUNCTIONS IN PROBLEMS OF ANALYTICAL DESIGN OF PULSE REGULATORS

P. D. Krut'ko *In its* Tech. Cybernetics No. 1, 1967 14 Apr. 1967 p 160–167 refs (See N67-24201 12-10)

The relationship has been established between the method of dynamic programming and Lyapunov functions for problems of optimization of quadratic bounds. Sufficient conditions are formulated for optimalness of systems with digital regulators. A specific example is investigated. Author

N67-24219 Joint Publications Research Service, Washington, D. C.

THE THEORY OF BEST APPROXIMATION OF OPTIMAL CONTROLS

I. P. Lytkin *In its* Tech. Cybernetics No. 1, 1967 14 Apr. 1967 p 168–172 refs (See N67-24201 12-10)

A method is proposed for the construction of the control which best approximates optimal control in the determinant sense of the word. A specific example is solved. Author

N67-24220 Joint Publications Research Service, Washington, D. C.

RANDOM SEARCH AS A MEANS OF DETERMINATION OF THE EXTREMUM OF THE FUNCTIONS OF SEVERAL VARIABLES

V. K. Chichinadze *In its* Tech. Cybernetics No. 1, 1967 14 Apr. 1967 p 173–186 refs (See N67-24201 12-10)

The problem of finding the global extremum in an n-dimensional space is investigated. The proposed procedure is illustrated by the determination of the global extremum of some equations having several extremal points. Author

N67-24221 Joint Publications Research Service, Washington, D. C.

THE SOLUTION OF A CLASS OF PROBLEMS OF MULTILOOP CONTROL

R. T. Yanushevskiy *In its* Tech. Cybernetics No. 1, 1967 14 Apr. 1967 p 187–197 refs (See N67-24201 12-10)

Some problems in the control of a linear multiloop object are investigated with step-restrictions on the control effects. It is assumed that the nature of the restrictions is different not only in the individual channels of the multiloop system, but also in certain time intervals in each channel. Author

N67-24222 Joint Publications Research Service, Washington, D. C.

THE ACCURACY OF NONLINEAR AUTOMATIC CONTROL SYSTEMS WITH RANDOM PARAMETERS

O. N. Fomenko *In its* Tech. Cybernetics No. 1, 1967 14 Apr. 1967 p 198–208 refs (See N67-24201 12-10)

A statistical method is proposed for investigating the accuracy of complex nonlinear automatic control systems in the case where the system operator changes from depending on the magnitude of the effective disturbances. Expressions are derived for the mathematical expectances and the dispersions of the output coordinates of the system for the given statistical disturbance characteristics. A simple example is presented to illustrate the method. Author

N67-24223 Joint Publications Research Service, Washington, D. C.

PREDICTION OF THE TRAJECTORIES OF STOCHASTIC SYSTEMS WITH AN INERTIAL METERING DEVICE

Yu. I. Parayev *In its* Tech. Cybernetics No. 1, 1967 14 Apr. 1967 p 209–228 refs (See N67-24201 12-10)

The problem of constructing an optimal estimate for the phase coordinates on some dynamic systems subject to the effect of random noise is investigated for the case where the coordinates are measured by an inertial device. Author

N67-24224 Joint Publications Research Service, Washington, D. C.

A PROBLEM IN OPTIMAL CONTROL OF SYSTEMS WITH DISTRIBUTED PARAMETERS

G. L. Degtyarev and T. K. Sirazetdinov *In its* Tech. Cybernetics No. 1, 1967 14 Apr. 1967 p 229–243 refs (See N67-24201 12-10)

The principle of the maximum is established as a necessary condition of optimalness of control of a nonlinear system of differential equations in partial derivatives which describes the process of heat and mass transfer in a uniform region if we neglect the processes of diffusion and thermal conductivity. The problem of determination of the optimal temperature field in a chemical reactor is investigated as an example. Author

N67-24225 Joint Publications Research Service, Washington, D. C.

ANALOG PROBABILITY SIMULATION OF SYSTEMS MADE OF UNRELIABLE ELEMENTS

V. M. Boychenko, V. S. Gladkiy, and Ye. M. Chernyy *In its* Tech. Cybernetics No. 1, 1967 14 Apr. 1967 p 244–262 refs (See N67-24201 12-10)

The problem of transformation of stochastic systems of different physical nature by probability graphs of the class of systems of unreliable binary elements is stated, and the method is proposed for analog probability simulation of such systems. Expressions are derived which relate the accuracy of the reproduction of the given reliability of the analog models with their high speed. The problem of synthesis of optimal models is solved. An experimental analog probability machine is described together with examples of the probability analysis of the stochastic networks in such a machine. Author

N67-24226 Joint Publications Research Service, Washington, D. C.

THE PROBLEMS OF OPTIMAL CONTROL OF THE PROCESS OF MONOCRYSTAL PULLING FROM A MELT

N. N. Golub' *In its* Tech. Cybernetics No. 1, 1967 14 Apr. 1967 p 263–269 refs (See N67-24201 12-10)

The problem of quality of monocrystal pulling from a melt is discussed. The problem of optimal control of the process of obtaining monocrystals of highest quality is formulated. The stated problem may be solved on the basis of the theory of optimal control of objects with distributed parameters using a digital computer. Author

N67-24227 Joint Publications Research Service, Washington, D. C.

THE ARTICLE BY O. B. KLESHKO "SYNTHESIS OF LINEAR AUTOMATIC SYSTEMS WITH RESPECT TO MINIMUM MEAN SQUARE ERROR TAKING INTO ACCOUNT THE INVARIABLE PART OF THE SYSTEM"

V. P. Fedyanin *In its* Tech. Cybernetics No. 1, 1967 14 Apr. 1967 p 270–277 refs (See N67-24201 12-10)

The difficulties which are encountered in finding the transfer function of a closed system with given excess of the power of the polynomial of the denominator over the numerator by the method proposed by O. B. Kleshko are pointed out. A new method is presented for finding the transfer function of a closed system permitting complete solution of the problem. Author

N67-24314# Library of Congress, Washington, D. C. Aerospace Technology Div.

RECURRENCE ALGORITHMS OF PATTERN RECOGNITION

L. Kacinskas *In its* Foreign Sci. Bull., Vol. 3, No. 3 Mar. 1967 p 15–19 refs (See N67-24312 12-23)

A general approach to deriving recurrence algorithms for teaching pattern recognition to automata based on the minimization of certain functionals is presented. It is shown how well-known pattern recognition algorithms derived by various authors can be obtained as particular cases of the general algorithms. A comparative analysis of derived and known algorithms is made. Author

N67-24482# Lincoln Lab., Mass. Inst. of Tech., Lexington.

A THEORETICAL ANALYSIS AND EXPERIMENTAL CONFIRMATION OF THE OPTIMALLY LOADED AND OVERDRIVEN *RF* POWER AMPLIFIER

David M. Snyder 7 Nov. 1966 42 p refs

(Contract AF 19(628)-5167)

(ESD-TR-66-564; TR-428; AD-647799) CFSTI: HC $3.00/MF $0.65

Although the textbook Class B approach to rf amplifier design yields high output power and reasonable collector efficiency (78.5 percent at maximum output power), neither the power nor the efficiency are optimum, and both are dependent on rf drive level. This report presents an analysis of appropriately selected collector voltage and current waveforms which determine the load impedance at the fundamental and harmonically related frequencies; these conditions define the Class B optimum efficiency case with 100 percent collector efficiency and 1.27 times the textbook Class B value of output power. If the rf drive level is increased and the collector voltage and current waveforms are appropriately selected so that the amplifier is overdriven, a different load impedance is determined; these conditions define the optimum power case with 1.46 times the textbook Class B value of output power and 88 percent collector efficiency. The optimum power case has the added advantage of resulting in an output power and collector frequency that are essentially constant over a predetermined range of drive level. Finally, the theory is verified by the construction and testing of a UHF power amplifier having a power output of 46 watts and an overall dc to rf conversion efficiency of 65 percent with an output power insensitivity to rf drive of 1 db for 10.5 db. Author (TAB)

N67-24622* Philco Corp., Santa Clara, Calif. Microelectronics Div.

[DESIGN, FABRICATION AND TESTING OF AN EIGHT-POLE COMMUTATOR AND ASSOCIATED SHIFT REGISTER] Quarterly Technical Report, 1 Nov. 1966–31 Jan. 1967

Bernard Aronson 6 Feb. 1967 30 p Prepared for JPL

(Contracts NAS7-100; JPL-951079)

(NASA-CR-83728; TR-S-67-102; QTR-2) CSCL 09C

Continuing research in the design, fabrication, and testing of a subsystem consisting of an eight-pole commutator, an associated shift register, and control logic is reported. The functional requirements are outlined, and steps defining the program method are listed. Details are given on the following areas of investigation: type of shift register, deck switch redundancy, modification of manufacturing process, analog switch saturation voltage, time relationship of logic inputs, and signal conditioning of logic units. Future research plans are summarized. L.E.W.

N67-24656# Radio Corp. of America, Princeton, N. J. RCA Labs.

INTEGRATED LOGIC NETS Final Report, Jul. 1, 1964–Nov. 30, 1966

Frederick P. Heiman Jan. 1967 33 p refs

(Contract AF 19(628)-4208)

(AFCRL-67-0006; AD-646726) CFSTI: HC $3.00/MF $0.65

The use of thin single-crystal silicon films deposited on single-crystal sapphire has yielded the most promising solution to the fabrication of complex complementary-MOS transistor integrated circuits. High-performance 10-transistor memory cells exhibiting a switching speed of less than 12 nsec at a power dissipation of 10 microwatts have been fabricated on thin silicon films. In addition, a 90-transistor word cell has been fabricated which dissipates only 90 microwatts for the entire circuit. The fabrication of both N- and P-channel transistors on a bulk silicon substrate has been accomplished through use of a composite wafer in which alternate bars of P- and N-type silicon are isolated by a thick layer of silicon dioxide. In addition, a two-wafer scheme involving a novel face-to-face soldering technique has provided an alternate approach to fabricating complementary-MOS transistor circuits. The technology necessary to yield a low-capacitance two-level intraconnection scheme has been developed, which allows the use of most vacuum-deposited dielectrics for the insulating layer; chemical etching of this layer is not necessary due to a novel technique used to introduce small holes in the insulating layer. Author (TAB)

N67-24732# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE BASES OF AUTOMATION AND TECHNICAL CYBERNETICS

A. A. Krasovskiy and G. S. Pospelov 23 Sep. 1966 1154 p refs Transl. into ENGLISH of the book "Osnovy Avtomatiki i Tekhnicheskoy Kibernetiki" Moscow, Gos. Energ. Izd., 1962 p 1–600

(FTD-MT-64-419; TT-67-60994; AD-646933) CFSTI: HC $3.00/MF $0.65

The book has three sections and contains a systematic account of the theory of elements of automatic devices, the theory of automatic control and the bases of technical cybernetics. A number of transmitters, amplifiers, controllers and regulating devices are discussed. The account of the theory of automatic adjustment includes the dynamics of linear, nonlinear and pulse systems of automatic control. The third section of the book - technical cybernetics - contains the theory of optimalizing control systems and the theory of systems with self-adjusting correcting devices. It touches on certain aspects of automating control processes. Author (TAB)

N67-24765# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

STABILIZATION OF A MAGNETIC FIELD BASED ON NUCLEAR RESONANCE

A. G. Alekseyev, V. M. Gerbovetskiy, and I. V. Mozin 27 Jun. 1966 9 p refs Transl. into ENGLISH from Nauchn.-Issled. Inst. Elektrofiz. App. Sb. Statey (USSR), no. 2, 1964 p 115–119

(FTD-TT-65-2045; TT-67-60792; AD-646454) CFSTI: HC $3.00/MF $0.65

A serious shortcoming of the systems of stabilization of a magnetic field based on the use of sensors of nuclear magnetic resonances (n.m.r.) is the extremely narrow band of the capture in

the system of regulation, such band constituting oersted units. In the absence of preliminary stabilization, this creates difficulties in the connecting in of the system and further, does not assure the restoration of the regime of stabilization after sharp changes in current in the electromagnet. A description is given of a system of automatic search for the signal of the sensor of n.m.r. and the capture in a regime of stabilization for a broad range of random changes in current in the electromagnet. This has made possible, without lowering the precision, the exclusion of preliminary stabilization in accordance with the current. Author (TAB)

N67-24954# Michigan Univ., Ann Arbor. Coll. of Literature, Science, and the Arts.
DEGENERATE AUTOMATA: SOME RELATIONSHIPS INVOLVING SEMIGROUP ORDER AND REGULAR EVENTS
Bernard Zeigler Dec. 1966 31 p refs
(Contract DA-31-124-ARO(D)-483)
(Rept.-03105-45-T; AD-647310) CFSTI: HC $3.00/MF $0.65

This report investigates some relationships involving the order of the semi-group of an automaton and a class of automata for which this order takes on its smallest value relative to the number of states. This class, called degenerate, is a limiting class in the sense that the semi-group order of any connected machine equals the number of states if it is degenerate, and is strictly greater than the state cardinality otherwise. Further, we show by counter-example that this result does not necessarily hold for disconnected machines even when they are reduced in appropriately defined manner. The lower bound on semi-group order is strengthened in the case of strongly connected automata. It is also shown that the class of degenerate automata, as herein defined, properly includes a variety of semi-group and group type automata studied in the literature. The relevance of semi-group order to the acceptance properties of automata is suggested. In particular, the number of subclasses and the minimum lengths of strings in an acceptor class are related to the semi-group order. Author (TAB)

N67-24972# Stanford Univ., Calif. Systems Theory Lab.
SEQUENTIAL DECISION FEEDBACK USING ORTHOGONAL SIGNALING
Anthony J. Kramer Aug. 1966 28 p refs
(Contract Nonr-225(83))
(SEL-66-076; TR-7050-10; AD-647044) CFSTI: HC $3.00/MF $0.65

Viterbi previously considered the effect of sequential decision feedback on communication over an additive white gaussian noise channel. In particular, he analyzed a suboptimum transmission scheme using M orthogonal signals and obtained an upper bound on the error probability. The present presentation proposes a different suboptimum system for the same problem and obtains an exact expression for the error probability. The error probability for the suboptimum scheme is always less than that for Viterbi's scheme and in fact shows significant improvement for rates near channel capacity. Author (TAB)

N67-24980# Illinois Univ., Urbana. Coordinated Science Lab.
SENSITIVITY ANALYSIS OF CERTAIN NONLINEAR CONTROL SYSTEMS
Oray Balasaygun Jan. 1967 52 p refs
(Contract DA-28-043-AMC-00073(E); Grant AF-AFOSR-931-66)
(R-335; AD-647461) CFSTI: HC $3.00/MF $0.65

It is well known that one of the main purposes of applying feedback is to reduce the system dependence or sensitivity to the usually undesirable parameter variations. A method of justifying the application of feedback would be to compare the perturbed responses with the nominal responses of the system with and without feedback control. In this thesis with the aid of the recent developments in the sensitivity theory by Bihovski, Romovic, Cruz, and Perkins, two such comparisons are made. The first one is a nonlinear model of a servomotor and the second one is the diving submarine example of Schoenberger. For these two examples it is shown that feedback control is superior to open loop control in the sense that the former is less sensitive to parameter variations. Author (TAB)

N67-24989# Stanford Univ., Calif. Systems Theory Lab.
SYNTHESIS OF TIME-VARYING PASSIVE NETWORKS
B. D. O. Anderson Oct. 1966 95 p refs Reprinted
(Contract Nonr-225(83); Grant AF-AFOSR-337-63)
(SEL-66-099; TR-6560-7; AD-646725) CFSTI: HC $3.00/MF $0.65

The investigation was concerned with the replacement of physical entities by models, upon which calculations may be performed; often the aim is to interpret physical conditions of the physical entity as mathematical conditions on some part of a mathematical model, or vice versa. The physical entities considered were time-varying electrical networks, which were often assumed to be imbued with physical properties such as linearity, passivity, and finiteness, all properties well known in more classical studies; the mathematical models considered were principally described by network matrices, such as the scattering matrix or impedance matrix. One aim was necessary, sufficient, or necessary and sufficient conditions on a scattering matrix for the associated network to be linear, or passive, or finite, or to possess any combination of these and other properties. The principal aim was means for passing from the network to a matrix description (analysis), and means for passing from a matrix to the network (synthesis). TAB

N67-25080*# Lehigh Univ., Bethlehem, Pa. Inst. of Research.
THE FIRST PASSAGE PROBABILITY AND CONTROL
Walter R. Henkel and F. P. Beer 15 Apr. 1967 26 p refs
(Grant NsG-466)
(NASA-CR-66349) CFSTI: HC $3.00/MF $0.65 CSCL 09C

It is shown how one may use the first-passage probability as a measure of performance in a stochastic control problem. Some general background is presented along with a mathematical formulation which lends itself to numerical computation. To demonstrate some of the details of computation an actual example is included. Author

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N67-23641*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE PROGRAMS SUMMARY 37-43, VOLUME IV FOR THE PERIOD DECEMBER 1, 1966 TO JANUARY 31, 1967. SUPPORTING RESEARCH AND ADVANCED DEVELOPMENT
28 Feb. 1967 418 p refs
(Contract NAS7-100)
(NASA-CR-83604) CFSTI: HC $3.00/MF $0.65 CSCL 22A

Space programs supporting research and advanced development are reviewed for the areas of systems analysis, spacecraft guidance and control, materials testing, propulsion systems, instrumentation, theoretical physics, and communications and telemetry. For individual titles see N67-23642–N67-23684.

N67-23644*# Jet Propulsion Lab., Calif. Inst. of Tech. Pasadena.
ENVIRONMENTAL REQUIREMENTS
A. S. Irons *In its* Supporting Res. and Advanced Develop. 28 Feb. 1967 p 53–58 refs (See N67-23641 12-11)

A microbiological evaluation of high efficiency particulate air (HEPA) filters was made with Bacillus subtilis var. niger spores under highly controlled conditions. No significant variations in performance between filters and in different areas of the filter assemblies were found, although some of the filters may fall below the critical efficiency level of 99.97%, which is the manufacturer's rating. The HEPA filters with an efficiency rating of 99.99+% can be used to remove all viable particles greater than 0.5μ from a gas stream. Areas of particulate penetration appeared to be directly related to an increase in velocity through holes or thin spots in the filter media or frames, and this velocity-efficiency relationship may provide a fairly rapid and easy means for evaluating the filters. M.W.R.

N67-23652*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
AERODYNAMIC FACILITIES
B. Walker, R. Prislin, M. Wilson, H. Holway, W. Marko et al *In its* Supporting Res. and Advanced Develop. 28 Feb. 1967 p 145–161 refs (See N67-23641 12-11)

Wind tunnels and the hypervelocity laboratory for environmental simulation studies are discussed. A wind tunnel test was made to determine the relative effectiveness of spherical and triangular boundary layer trips in promoting artificial transition from laminar to turbulent flow on a flat plate. Determinations were made of the dynamic stability derivatives from trajectories for bodies with nonlinear asymmetric aerodynamics; and results are reported for transonic free flight testing, aeroshell separation, influence of linearly varying density on the flight envelope, Reynolds number effect on stability, and aerodynamic loads on a blunt cone with various complex aft-body configurations. Gas dynamic flow studies in the hypervelocity laboratory are discussed as part of a program to experimentally verify a theoretical method of estimating the hypersonic field flow about bodies in unsteady flight. M.W.R.

N67-23699# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
STREAMER CHAMBER WITH γ-QUANTUM CONVERTER [STRIMERNAYA KAMERA S KONVERTORAMI γ-KVANTOV]
V. F. Vishnevskii 1966 7 p refs In RUSSIAN
(JINR-P13-3068) CFSTI: HC $3.00/MF $0.65

A design of a streamer chamber is described which allows one to put γ-quantum converters in the form of lead glass plates into the chamber volume. The chamber was tested in cosmic rays. Author (NSA)

N67-23729# California Univ., Berkeley. Lawrence Radiation Lab.
HIGH-GRADIENT DRIFT-TUBE QUADRUPOLE MAGNETS
Robert M. Main, James M. Haughian, and Robert B. Meuser 28 Sep. 1966 14 p Presented at the Linear Accelerator Conf., Los Alamos, N. Mex., 3–7 Oct. 1966
(Contract W-7405-ENG-48)
(UCRL-17156; CONF-661021-28) CFSTI: HC $3.00/MF $0.65

A new design for small high-gradient magnetic quadrupoles was devised. This design utilizes a keyed-quadrant yoke-pole configuration which ensures fourfold symmetry of the pole. The coils are tape-wound, occupying the entire slot area and thus minimizing power consumption and cooling problems. The lenses are expected to achieve pole-tip fields in excess of 10 kG and gradients of more than 25 kG/in. for a 3/4 in. aperture. Methods of winding coils, insulating problems, steel configuration, and cooling schemes are discussed. Author (NSA)

N67-23759# Soreq Research Establishment, Israel Atomic Energy Commission, Yavneh.
LABORATORY APPARATUS FOR THE INVESTIGATION OF SPRAY REACTIONS WITH THE AID OF RADIOACTIVE TRACERS
E. Foa, M. Konigsbuch, S. Lask, O. Schachter, and Z. Stuhl Jan. 1966 9 p
(IA-1078) CFSTI: HC $3.00/MF $0.65

An apparatus is described, which was built for studying the reactions occurring in a stationary drop. Single droplets of salts labeled with a suitable radioisotope are heated in a current of gas. It is possible to measure the change in the activity of the droplet and/or of the escaping gases, which are absorbed. The apparatus permits the study of the influence on reaction kinetics of temperature; drop size; the flow-rate, composition and humidity of the gases; and the concentration of the solutions. Author (NSA)

N67-23771# Brookhaven National Lab., Upton, N. Y.
DESIGN STUDY FOR A 1000-MeV BOOSTER SYNCHROTRON INJECTOR FOR THE BROOKHAVEN AGS
M. Q. Barton, J. P. Blewett, E. D. Courant, A. W. Maschke, I. Polk et al 13 Dec. 1966 82 p refs
(Contract AT(30-2)-GEN-16)
(BNL-10884) CFSTI: HC $3.00/MF $0.65

The design study of a 1000-MeV booster synchrotron injector for the BNL AGS is outlined. Topics included are choice of injector synchrotron; choice of injector energy; basis for booster design; booster synchrotron design, including magnet design, injector, lattice structure, magnet power supply, poleface windings, vacuum chamber, rf system, initial betatron acceleration, injection, extraction, phase-space rotation, instrumentation and control, shielding and buildings; possible use of present AGS linac as injector for the booster; and cost estimates. NSA

N67-23959*# Philco Corp., Palo Alto, Calif. Space and Re-Entry Systems Div.
INVESTIGATION OF THE USE OF A RADIOISOTOPE FOR SPACE ENVIRONMENT SIMULATION Final Report
D. M. Newell 19 Mar. 1967 83 p refs
(Contract NAS2-3506)
(NASA-CR-73082; SRS-TR-150) CFSTI: HC $3.00/MF $0.65 CSCL 14B

Discussed is the incorporation of a beta-emitting radio isotope in an environmental simulation chamber which already included control of the parametric variables of vacuum (gaseous environment), sample temperature, and solar electromagnetic radiation. Described are the theoretical and analytical bases for selection and design of a sealed strontium 90–yttrium 91–titanate source, spectral calibration of the resultant source, electron dosimetry determinations at the sample sites within the chamber, operating experiences, prototype specimen exposure test results, and system evaluation. The resulting electron spectrum was measured; it includes electrons in the 35 keV to 2.0 MeV range, which compares favorably with the electron spectra for 800, 1500, and 18,000 nautical mile equatorial orbits. Flux levels similar to real space environment were achieved. Solar radiation covering the spectral range from 0.2 to 1.4 microns was provided simultaneously with the electron irradiation. Samples of thermal control materials were irradiated in the combined environment for 765.5 hours without interruption. K.W.

N67-24061# Los Alamos Scientific Lab., N. Mex.
PROCEEDINGS OF THE 1966 LINEAR ACCELERATOR CONFERENCE
John W. McDonald, ed. Dec. 1966 641 p refs Conf. held in Los Alamos, N. Mex. 3–7 Oct. 1966
(Contract W-7405-ENG-36)
(LA-3609) CFSTI: $3.00

Conference papers are presented on proposed linear accelerator designs, operating experience and measurements, accelerating

structures, component design and evaluation, particle dynamics, beam blowup and loading, space charge, ion sources and columns, RF power sources and controls, and cryogenics. For individual titles, see N67-24062 through N67-24140.

N67-24062# Brookhaven National Lab., Upton, N. Y.
LINACS OF THE FUTURE
J. P. Blewett *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 1–3 (See N67-24061 12-11)

The high cost of linear accelerators has inspired the development or invention during the past few years of a number of competitors, particularly for use as synchrotron injectors, and the lower cost of at least some of these devices will probably result in their use in applications where formerly the linac seemed to be the natural choice. For example, the AGS conversion program originally included a 200-MeV linac to be extended in a later phase to 500 MeV. Now it appears that the linac will not be used for energies above 200 MeV; the second phase will probably involve a booster synchrotron with an output at about 1 GeV, expected to cost less than the 200 to 500 MeV linac extension.
Author (NSA)

N67-24063# Stanford Univ., Calif. Linear Accelerator Center.
INITIAL OPERATING EXPERIENCE AND PERFORMANCE OF THE SLAC ACCELERATOR
R. B. Neal *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 4–19 refs Sponsored by AEC (See N67-24061 12-11)

The evolution of the design of the two-mile accelerator is given. A brief review of the final design configuration of the accelerator and some of its principal components are given here. During the summer of this year, an electron beam was successfully accelerated through the two-mile machine and a maximum energy of 18.4 GeV was obtained. Extensive testing has shown that the accelerator meets specifications in almost all respects. The only notable exception to this statement is the failure to attain rated beam current due to the onset of "beam break-up" phenomena.
Author (NSA)

N67-24064# National Bureau of Standards, Washington, D. C.
THE NBS LINAC
J. E. Leiss *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 20–27 (See N67-24061 12-11)

The NBS linear electron accelerator, which is a facility designed for a varied program in nuclear and radiation physics, is discussed. Topics included are accelerator components such as waveguide structures, injectors, microwave system, cooling system, modulators, rf distribution system, and analyzing magnets; facility layouts; and beam handling.
NSA

N67-24065# Brookhaven National Lab., Upton, N. Y.
MEASUREMENTS AND CALCULATIONS ON THE 50-MeV BROOKHAVEN LINAC
K. Batchelor, R. Chasman, and T. Werntz *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 28–33 refs Sponsored by AEC (See N67-24061 12-11)

The proposed AGS Conversion Program calls for accelerated peak beam currents in excess of 100 mA from the new injector linac. The data presented represent a series of measurements and calculations carried out on the existing linac. Although the results were taken with an accelerated beam current in the region of 30 mA, many of the results are directly applicable to the new proposal since the present cavity length is more than one and a half times greater than any cavity in the new proposal. Measurements of the transient and steady-state phase and amplitude changes between center and end of the center-fed cavity are presented, together with calculated values obtained from the theory of T. Nishikawa. Beam energy measurements are also presented together with some computational data.
Author (NSA)

N67-24066# California Univ., Livermore. Lawrence Radiation Lab.
MEASUREMENTS OF THE LINEAR-ACCELERATOR EXIT BEAM OF THE BEVATRON INJECTOR
Robert W. Allison, Jr., Don M. Evans, Robert M. Richter, Allen J. Sherwood, and Emery Zajec *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 34–47 refs Sponsored by AEC (See N67-24061 12-11)

A series of measurements of the characteristics of the linear accelerator (linac) exit beam were made to determine if variations in beam position, emittance, and energy spread were present. These measurements show that beam-position movements due to voltage ripple on the preinjector and linac rf systems occur. Positions were measured with a resonant 200-MHz induction electrode which detects the center of gravity of the beam. In addition, a series of momentum measurements were made to study filamentation of the linac beam, and the effect of the prebuncher and debuncher. A correlation has been obtained between energy ripple and the beam position jitter. An emittance device that uses a sweeping magnetic field for measuring emittance was constructed, and a preliminary study was made of the linac emittance variation with intensity and tank gradient.
Author (NSA)

N67-24067# European Organization for Nuclear Research, Geneva (Switzerland).
THE CERN-PS LINAC Progress Report
C. S. Taylor, D. J. Warner, F. Block, and P. Tetu *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 48–59 refs (See N67-24061 12-11)

The behavior of the CERN-PS Linac at currents of 50 to 100 mA is discussed. The difficulties of bunching at the higher currents are first described, and then the transverse beam properties at 50–60 mA, in particular blow-up, are discussed in detail as a background to the behavior at 100 mA. The measures which are being taken to combat beam loading are described, and the heating effects of the high brilliance 500 keV beam mentioned. A method of emittance measurement using a computer is reported, and some comments on our experience with the statistical analysis of machine parameters are given.
Author (NSA)

N67-24068# Argonne National Lab., Ill.
RECENT OPERATING EXPERIENCE WITH THE ZGS INJECTOR LINAC
Rolland Perry *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 60–64 Sponsored by AEC (See N67-24061 12-11)

The reliability of the ZGS is outlined after four years of operation. The performance of its major components (preaccelerator, ion source, and rf system) is discussed. Modification to components of the ZGS is reported. These components were the rf system, hydraulic power system for preacceleration, high gradient accelerating column, and variable energy debuncher. A brief review of the experiments in progress is also presented.
NSA

N67-24069# Stanford Univ., Calif.
MEASUREMENTS OF THE SLAC INJECTOR EMITTANCE
Roger H. Miller *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 65–71 refs Sponsored by AEC (See N67-24061 12-11)

The six-dimensional volume in phase space enclosing the beam from the SLAC injector has been measured. The design of the injector and preliminary measurements on the prototype injector were reported at the National Particle Accelerator Conference. This paper reports on similar measurements on the completed injector as installed on the SLAC two-mile accelerator. The measurement methods reported here for both transverse and longitudinal phase volumes differ significantly from those used on the prototype injector. The transverse phase space measurement on the prototype used the two-slit method described by van Steenbergen. The

method reported here used a variable aperture plus a glass plate (equivalent to the photographic film). NSA

N67-24070# California Univ., Berkeley. Lawrence Radiation Lab.
PARTIAL ENERGY BEAMS FROM AN ION LINAC
A. Ghiorso, E. L. Hubbard, R. M. Main, D. A. Spence, and F. Voelker *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 73–77 refs Sponsored by AEC (See N67-24061 12-11)

The 70 mHz linac is divided into two Alvarez cavities. The beam is injected into the first cavity (pre-stripper tank) by a Cockcroft–Walton injector at an energy of 70 keV/nucleon ($\beta = 0.012$). The pre-stripper is a 15 ft (4.6 m) long grid-focussed machine that accelerates the ions to 1 MeV/nucleon ($\beta = 0.045$). Between cavities electrons are stripped from the ions by passing the beam through a thin beryllium-oxide foil. The second cavity (post-stripper tank) accelerates the particles to their final energy of 10.3 MeV/nucleon ($\beta = 0.15$). Focussing is provided by quadrupole magnets in each of 67 cylindrical drift tubes. The quadrupoles are connected in groups of two, except for the first one and the last six which are connected to individual power supplies. Each group can be tuned independently of the other groups. NSA

N67-24071# Argonne National Lab., Ill.
PERFORMANCE CHARACTERISTICS OF THE ZERO GRADIENT SYNCHROTRON LINAC AUTOMATIC GRADIENT STABILIZER
R. W. Castor and J. Abraham *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 78–82 Sponsored by AEC (See N67-24061 12-11)

The performance characteristics of the 5 Mc and 26 Mc automatic gradient stabilizers for the ZGS linac are reported. NSA

N67-24072# Los Alamos Scientific Lab., N. Mex.
ACCELERATING STRUCTURE RESEARCH AT LOS ALAMOS
E. A. Knapp, P. W. Allison, C. R. Emigh, L. N. Engel, J. M. Potter et al *In its* Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 83–87 refs (See N67-24061 12-11)

The design of a novel accelerating tank utilizing the electrical stability of the $\pi/2$ mode of operation, but having shunt impedances characteristic of the π-mode of operation has been described. This side coupling principle, with some modifications, is now used in the accelerating system for the proposed L.A.M.P.F. Meson factory Linac. Several refinements in design have been made which raise the shunt impedance of this type system considerably above the values quoted in previous reports. In addition high power tests have been completed showing the design will withstand high gradient operation with no adverse characteristics. In prototype construction no fabricational problems have arisen. Author (NSA)

N67-24073# Brookhaven National Lab., Upton, N. Y.
MEASUREMENT ON A MULTISTEM DRIFT TUBE STRUCTURE
S. Giordano and J. P. Hannwacker *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 88–95 refs Sponsored by AEC (See N67-24061 12-11)

A new standing wave structure, operating in the TM_{010} mode, for accelerating protons below an energy of 200 MeV is described. This structure employs more than one stem to support each drift tube, and unlike the conventional drift tube structure the stems play a significant role in shaping the dispersion curve about the operating TM_{010} mode. The purpose of this paper is to describe in more detail the operating characteristics of a multistem structure. The measurements were carried out on a cylindrical cavity, having a length of 36 in. and a diameter of 10.8 in. Of particular interest for the present discussion are the $TM_{01\phi}$ and $TE_{11\phi}$ modes. Author (NSA)

N67-24074# Paris Univ., Orsay (France). Institut d'Electronique Fondamentale.
SELF FOCUSING IN HEAVY ION LINACS
D. Boussard *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 96–103 refs (See N67-24061 12-11)

The focusing of the first sections of heavy ion linear accelerators may be achieved without the use of grids or magnetic quadrupoles by employing conveniently ended drift tubes. The ion motion is theoretically studied in a structure using drift tubes which are lengthened by two diametrically opposite fingers. We show that is it possible to ensure simultaneously radial and axial stabilities of the beam. Using a low energy model (200 keV) energy spectrum and current yield of this new structure were measured. Experimental results are very interesting: current yield is as high as 20%, for a 21 drift tubes linac, and it rises above 60% by using a bunching device. These results are in good agreement with the theory, and the construction of self focused linacs seems to be possible with this method. Theoretical results concerning breakdown voltages, trajectories, acceptance, obtained in a real case (injector of the variable energy cyclotron in Orsay) are given. It is concluded that this new method has many attractive features and may be employed successfully to design the first sections of heavy ion linacs. Author (NSA)

N67-24075# Brookhaven National Lab., Upton, N. Y.
APERTURE AND CELL SIZE EFFECTS OF SHUNT IMPEDANCE OF ALTERNATING PERIODIC STRUCTURES
D. Carter (San Jose State Coll.) and T. Nishikawa (Tokyo Univ.) *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 104–108 refs Sponsored by AEC (See N67-24061 12-11)

Compared to an equivalent uniform periodic structure (hereinafter referred to as UPS) operated, for maximum shunt impedance, in its resonant π mode, the APS in a $\pi/2$ mode enjoys great advantages in relative immunity from beam loading and detuning effects. It has been shown that, while such advantages (which depend mainly on the frequency separation between the operating and adjacent resonant modes) are attributable only to the difference in the operating mode, shifting operation from the π to the $\pi/2$ mode in a UPS would involve a price of significantly lowered shunt impedance. The APS, on the other hand, obtains such advantages of increased stability while sacrificing little in shunt impedance because of an improved transit time factor attributable to the structure. In fact, an approximate calculation predicted that the shunt impedance of an APS in a $\pi/2$ mode might actually be better than that of UPS in its π mode. Author (NSA)

N67-24076# Los Alamos Scientific Lab., N. Mex.
TRANSVERSE MODES IN A RESONANTLY COUPLED ACCELERATOR
J. M. Potter *In its* Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 109–114 (See N67-24061 12-11)

In predicting the possibility of transverse mode beam blow-up in a linear accelerator it is useful to have some idea of the transverse mode shunt impedance of a typical accelerating cell. This paper disucsses the techniques for identifying the modes associated with beam blow-up and for measuring their shunt impedance. A family of six $\beta = 0.65$ cavities of similar geometry and varying diameters, typical of the accelerating cells in the LASL $\pi/2$ mode structures, and with the TM_{010} mode near 805 MHz were studied. The results of these measurements are presented. Author (NSA)

N67-24077# Brookhaven National Lab., Upton, N. Y.
LINAC CAVITY FIELD CALCULATIONS
P. F. Dahl, K. Jellett, G. Parzen, S. Giordano, D. Young (Midwestern Univ. Res. Assoc., Stoughton, Wis.) et al *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 115–118 ref Sponsored by AEC (See N67-24061 12-11)

The resonant frequency and the electromagnetic fields of linac cavities can be computed by mesh-relaxation computer programs. It is of interest to establish the accuracy of these computer programs. It is difficult to establish the accuracy from theoretical considerations. An estimate of the accuracy can be made by comparing the results of the computer programs with experimentally measured results. The mesh-relaxation computer programs used were the JESSY program and the MESSYMESH program. The results of these computer programs were compared with the results of other experiments. Author (NSA)

N67-24078# Los Alamos Scientific Lab., N. Mex.
DESIGNING RESONANT CAVITIES WITH THE LALA COMPUTER PROGRAM
Harry C. Hoyt *In its* Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 119–124 ref (See N67-24061 12-11)

This paper reports a few of the cavity design studies which have been carried out at the Los Alamos Scientific Laboratory using the LALA computer program. The three studies included are concerned with $\beta = 0.65$ proton linac cavities, $\beta = 1$ electron linac cavities, and the cavity in the coaxitron microwave amplifier tube. Briefly, the program is a numerical mesh calculation which determines the fields and frequency of a resonant cavity having cylindrical symmetry. The wave equation, together with appropriate boundary conditions, is solved by the use of difference equations and the method of relaxation. Only those modes which have no θ-component for the electric field are considered. Usually we are concerned with the lowest frequency mode. Design parameters such as the transit time factor T, power loss P, Q, and the shunt impedance per unit length ZT^2 are computed from the field distribution obtained for a given cavity. Author (NSA)

N67-24079# Los Alamos Scientific Lab., N. Mex.
CIRCUIT ANALOG TECHNIQUES FOR ANALYSIS OF RESONANTLY-COUPLED LINEAR ACCELERATOR STRUCTURES
G. R. Swain *In its* Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 125–131 refs (See N67-24061 12-11)

For simple accelerator structures, such as the Alvarez configuration and the iris-loaded waveguide, analysis of the coupled fields is possible, usually with the aid of a few simplifying approximations. The dispersion relation and even the transient response have been obtained in this way. On the other hand, a circuit analog can permit one to investigate the expected performance of a structure without having to investigate the detailed configuration of the fields. The circuit analog is capable of giving insight to the nature of the dispersion relation, the optimum tuning of the individual cells, the amount of degradation in performance to be expected from tuning errors or other errors, and the expected performance under a given set of operating conditions. These capabilities have proved very useful at Los Alamos, where side-coupled and cloverleaf accelerator structures have been under study. A number of relations between the field approach and the circuit analog approach have been worked out, but with certain assumptions regarding the nature of the coupling between the cavities. The application of the circuit analog to the study of resonantly-coupled accelerator structures will be discussed in this paper. Author (NSA)

N67-24080# Los Alamos Scientific Lab., N. Mex.
TUNING AND FIELD MEASUREMENT TECHNIQUES IN A RESONANTLY COUPLED ACCELERATOR TANK
L. N. Engel and E. A. Knapp *In its* Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 132–136 refs (See N67-24061 12-11)

The tuning and measurements made on a long cavity chain designed to check the predictions of the theory and develop fabricational and tuning techniques useful for mass production of cavity chains of this type are given. An 805 MHz, side-coupled, 39 accelerating cell, experimental model was fabricated and tuned. Designed to have a constant phase velocity of 0.65 speed of light, this tank was the first accurately fabricated side-coupled cavity chain of any appreciable length studied so far. The results of the study on this model showed that the predictions of the equivalent circuit analysis for $\pi/2$ mode structures were verified in all cases where direct experimental tests were feasible; an economical and practical method of tank fabrication was developed; and tuning techniques adaptable to the mass production of long tanks were devised. Final results of the low power tuning indicate that the tank has a resonant frequency of 804.910 MHz for the $\pi/2$ mode, a stop band of 19.2 kHz, a shunt impedance ZT^2 of 28.9 MΩ/m, and a maximum electric field variation of $\pm 1.2\%$ within the tank. The phase shift from one end to the other was essentially zero. NSA

N67-24081# Los Alamos Scientific Lab., N. Mex.
OPERATING CHARACTERISTICS OF A FULL POWER CLOVERLEAF ACCELERATOR TANK
D. R. Copenhagen, E. A. Knapp, and J. M. Potter *In its* Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 137–139 refs (See N67-24061 12-11)

An 805 MHz, forth-one cell cloverleaf accelerator tank has been fabricated and evaluated. The operating parameters as well as the tuning procedures and problems associated with this particular model are discussed. Results from both low and high power tests are included. Author (NSA)

N67-24082# Midwestern Universities Research Association, Stoughton, Wis.
RF PERTURBATION MEASUREMENTS IN LONG LINAC CAVITIES
C. W. Owen, C. A. Radmer, and D. E. Young *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 140–145 refs Sponsored by AEC (See N67-24061 12-11)

The problem of assembling a series of unit cells into a long linac cavity resonant at the same frequency as the separate cells is a difficult problem for the designer and cannot be solved with an arbitrary accuracy. For this reason, all linacs are constructed with tuners to provide local variations in frequency or acceleration field. The adjustment of the tuners to eliminate the local variations of the fields is a necessary tune-up procedure. Because of the difficulty of reading, calibrating, interpreting, and relating magnetic pickup probe readings on the outer wall to the axial accelerating fields, a measurement of these fields directly is preferred. The usual method of measurement of the axial field is by the use of perturbation techniques. In order to use the perturbation method in long linac cavities, special equipment has been developed to allow the small perturbations in the frequency to be accurately measured. Author (NSA)

N67-24083# California Univ., Berkeley. Lawrence Radiation Lab.
MEASUREMENTS ON A MODEL rf MANIFOLD SYSTEM
Ferdinand Voelker *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 146–152 refs Sponsored by AEC (See N67-24061 12-11)

A one-tenth-scale rf manifold system with six cavity loads and several amplifiers operating at 200 MHz was set up. The manifold is a 50-ft-long coaxial line, and the cavities are foreshortened quarter-wave resonators with about 25 higher-order resonances below 2GHz. The measurement program consists of three parts. The first part consists of steady-state measurements of amplitude and phase along the system in the principal pass-band. The second part consists of measurements during the rise and fall time in pulsed operation. The third part consists of measurement of higher-order modes of the system which are excited by very short pulses of current (≈0.25 nsec) in the gaps of the cavities. Author (NSA)

N67-24084# California Univ., Berkeley. Lawrence Radiation Lab.
HIGH-GRADIENT DRIFT-TUBE QUADRUPOLE MAGNETS
Robert M. Main, James M. Haughian, and Robert B. Meuser *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 153–156 Sponsored by AEC (See N67-24061 12-11)

A new design for small high-gradient magnetic quadrupoles has been devised. This design utilizes a keyed-quadrant yoke-pole configuration which ensures fourfold symmetry of the pole. The coils are taped-wound, occupying the entire slot area and thus minimizing power consumption and cooling problems. The lenses are expected to achieve pole-tip fields in excess of 10 kG and gradients of more than 25 kG/in. for a 3/4-in. aperture. Methods of winding coils, insulation problems, steel configuration, and cooling schemes are discussed. Author (NSA)

N67-24085# Los Alamos Scientific Lab., N. Mex.
MECHANICAL DESIGN OF DRIFT TUBES AND QUADRUPOLE MAGNETS FOR THE ALVAREZ LINAC
E. D. Bush, Jr. *In its* Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 156–162 refs (See N67-24061 12-11)

This paper describes efforts at Los Alamos directed toward the mechanical design of drift tubes, drift tube stems, and quadrupole magnets for the 201.25-MHz Alvarez linac. The linac features necessitating this design effort are the high rf duty factor which may go as high as 12%, and the large time average current of one mA. Topics covered are limited to preliminary drift tube design with emphasis placed on the quadrupole magnets and their associated coils. Detailed effort on the final alignment mechanism and stem design has been temporarily suspended awaiting selection of the number and configuration of the drift tube stems. In the following sections our current drift tube designs, cooling schemes and fabrication techniques are discussed. Our approach to the quadrupole magnet design, fabrication, and analysis is outlined along with a description of the coated coil development program. Author (NSA)

N67-24086# Stanford Univ., Calif. Linear Accelerator Center.
SLAC ALIGNMENT SYSTEM
W. B. Herrmannsfeldt *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 163–168 refs Sponsored by AEC (See N67-24061 12-11)

This paper presents a review of the operating experiences with the laser alignment system of the two-mile linear accelerator. It includes discussions of some of the special alignment techniques used prior to the initial start up of the accelerator. Author (NSA)

N67-24087# Los Alamos Scientific Lab., N. Mex.
DESIGN, DEVELOPMENT, AND FABRICATION OF MULTICAVITY 805 MHz ACCELERATOR TANKS
H. G. Worstell *In its* Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 169–175 (See N67-24061 12-11)

The development of full scale 805 MHz tank models for the proposed LAMPF accelerator has been both challenging and unique from the engineering standpoint. In the design and fabrication of these models one must take into consideration such things as materials, machining, joining techniques, allowable stresses (especially at elevated temperatures), good quality control at all times, heat transfer and the provision of an evacuation system capable of maintaining a good clean high vacuum under full power operation. Most of these engineering problems are further aggravated by the extensive use of OFHC copper with its inherently very poor mechanical properties. Author (NSA)

N67-24088# Midwestern Universities Research Association, Stoughton, Wis.
HIGH FIELD MEASUREMENTS AT 200 MHz IN CONVENTIONAL PROTON LINEAR ACCELERATOR GEOMETRIES AT 5, 50, AND 130 MeV
C. W. Owen, C. A. Radmer, and D. E. Young *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 176–182 refs Sponsored by AEC (See N67-24061 12-11)

Sparking and electron emission studies which were undertaken at MURA are reported. These were restricted to 200 MHz in linear accelerator cavities of the accelerator type with 500 μsec pulses and a 1% duty cycle. NSA

N67-24089# Brookhaven National Lab., Upton, N. Y.
EXPERIMENTAL RESULTS ON THE RCA 7835, AND INITIAL OPERATING PARAMETERS OF THE FTH 515
J. T. Keane and A. J. McNerney *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 183–190 Sponsored by AEC (See N67-24061 12-11)

With increasing demand for higher proton linac output currents a corresponding increase in 200 megacycle power generation is required. The work done on two separate rf high power sources at Brookhaven will be presented. The first source uses the RCA 7835 super power triode and the other uses the newly developed Thomson–Houston 515 Vapodyne triode. The resonant cavity for the RCA 7835 triode was constructed by Continental Electronics of Dallas, Texas. Their design is similar to the previous cavity they supplied to Argonne National Laboratory but with a major modification of the output cavity. Our cavity can be pressurized up to 60 psig and the output transmission line is of the coaxial line type instead of a rectangular guide. Use of the coaxial line enabled us to incorporate the ability to vary the loading on the tube. Author (NSA)

N67-24090# Los Alamos Scientific Lab., N. Mex.
MODULATOR DEVELOPMENT AT LOS ALAMOS SCIENTIFIC LABORATORY
Robert W. Freyman and Rudolph P. Severns *In its* Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 191–193 refs (See N67-24061 12-11)

The modulator has met all initial design objectives. The switch tube has met all design objectives. Changing programmatic requirements of 40% correction of output voltage in 1 micro-second seems within reach. The switch tube may be used as a high voltage disconnect during faults to prevent crowbarring capacitor bank. Size (6 ft. square), maintenance, and cost ($8,000.00) are reasonable. Author (NSA)

N67-24092# Applied Radiation Corp., Walnut Creek, Calif.
ENERGY SPECTRUM IMPROVEMENT WITH THE HEM-11 MODE
W. J. Gallagher *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 196–197 refs (See N67-24061 12-11)

As a result of both theoretical and experimental work on the HEM-II mode in the disc loaded waveguide it is apparent that it would be practical to use this structure for improvement of the energy spectrum of the electron linear accelerator. A proposed scheme is presented. The nearly parallel beam is transmitted through a dispersive isochronous momentum (energy) analyzer in such a manner that a parallel beam is formed, with the particles arranged transversely as a function of energy. If the bunches of the beam are synchronized with the longitudinal electric field of the HEM-II mode of the waveguide particles passing down the axis will be unaffected while off-axis particles will be accelerated (or retarded) proportionally to their displacement. Adjustment of the power level will form the emerging beam into a nearly monoenergetic slit or ribbon beam which can then be focused onto the target by quadrupole lens. Synthesis of an appropriate magnet system is not unique and further discussion is omitted. Author (NSA)

N67-24093# Compagnie Generale de Telegraphie sans Fil, Orsay (France).
PHASE MEASUREMENT ALONG LINAC SECTIONS BY A RESONANT METHOD
B. Epsztein and D. Tronc *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 189–200 refs (See N67-24061 12-11)

During the construction of an electron linac, it is necessary to check the amplitude and phase of the rf field along the accelerating structure, in particular along the bunching section. It is then possible with the help of a computer to deduce the behavior of the electron beam during operation and by modifications of the structure, to optimize it. A method which relies on resonance perturbation technique was developed for this purpose. NSA

N67-24109# Tokyo Univ. (Japan). Dept. of Physics.
BEAM LOADING EFFECTS IN STANDING WAVE LINACS
T. Nishikawa *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 294–302 refs (See N67-24061 12-11)

A brief review of beam loading effects in standing-wave linacs are described in terms of the microwave cavity theory (normal mode analysis of standing-wave linacs). NSA

N67-24110# Massachusetts Inst. of Tech., Cambridge.
OPTIMIZATION CRITERIA FOR STANDING WAVE TRANSVERSE MAGNETIC DEFLECTION CAVITIES
Jacob Haimson *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 303–331 refs (See N67-24061 12-11)

The use of standing-wave transverse magnetic deflection cavities as a prebuncher for linear accelerators, in order to achieve narrow energy spectra, is discussed. Topics included are microwave characteristics, beam deflection, and aberration calculations. NSA

N67-24111# Compagnie Generale de Telegraphie Sans Fil, Orsay (France).
TRANSIENTS IN ELECTRON LINACS
B. Epsztein and J. P. Mangin *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 332–335 refs (See N67-24061 12-11)

A number of physics studies require short pulses and high peak currents from electron linacs. The duration of these pulses can be much shorter than the filling time of the accelerator, in which case the operation cannot reach a steady state. Hence, it is necessary to develop a theory valid for such conditions. The main result of a study was a large increase of the beam-loading during the initial period of the beam pulse (about ten rf cycles) with respect to what would be computed in a conventional manner, disregarding the dispersion of the wave guide. A study was initiated with two main objects in mind: First, to get a better physical understanding of the phenomenon and its causes since the mathematical intricacy of Leiss' analysis did not allow an intuitive appraisal of the situation. Second, to obtain approximate analytic expressions for the beam loading in order to avoid the use of computers and be able to appreciate rapidly the influence for each parameter. The unexpected result was that this study did not show any trace of the extra beam loading discovered by Leiss, in spite of the fact that most initial assumptions were identical for both cases. Instead, our result is very close to the one obtained in the more naive approach neglecting dispersion effects. Details of this analysis, followed by a discussion on the reasons for the discrepancy are presented. Author (NSA)

N67-24112# Argonne National Lab., Ill.
TRANSIENT WAVE PROPAGATION IN LINEAR ACCELERATORS
J. Abraham *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 337–342 refs Sponsored by AEC (See N67-24061 12-11)

The determination of the velocity with which energy propagates in a cavity is discussed from observations made on the 50 MeV proton linac (Alvarez structure) at Argonne National Laboratory. For the purpose of analysis, it is assumed that the steady-state condition obtains when the amplitudes of the forward and backward traveling waves are equal and, furthermore, that all transients can be explained in terms of these waves. Specifically, when a transient occurs, the forward and backward wave are unequal and the envelope of the disturbance is the output of a detector. NSA

N67-24113# European Organization for Nuclear Research, Geneva (Switzerland).
THE DUOPLASMATRON SOURCE FOR THE CERN-PS LINAC
B. Vosicki, M. Busic, and A. Cheretakis *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 344–354 refs (See N67-24061 12-11)

In order to improve the performance of the CERN-PS, the development of the DP ion source and associated high gradient column was undertaken. The conception, construction of the DP, and the results obtained during the first few months of operation are described. Author (NSA)

N67-24114# European Organization for Nuclear Research, Geneva (Switzerland).
THE NEW 500 KeV SINGLE-GAP PRE-INJECTOR TUBE FOR THE CERN PROTON SYNCHROTRON LINAC
J. Huguenin, R. Dubois, G. Visconti, and R. EL-Baz *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 355–364 refs (See N67-24061 12-11)

The conception, testing, and operational behavior of single or two-gap (adjustable from 7.5 to 12.5 cm) high gradient (≈45 to 75 kV/cm) dc pre-injector accelerating tube for the CERN proton synchrotron are described. NSA

N67-24115# Midwestern Universities Research Association, Stoughton, Wis.
INITIAL TESTS OF THE MURA HIGH GRADIENT COLUMN
C. D. Curtis, G. M. Lee, and J. A. Fasolo *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 365–370 refs Sponsored by AEC (See N67-24061 12-11)

The MURA high gradient column has been voltage tested to 600 kV with a brief conditioning time. Current drawn from the electrodes appears negligible. In tests for a few days with an ion source in operation, preliminary data on accelerated beam quality indicate quite small aberrations due to a focusing lens introduced following the source. Some indicated increase in emittance of the accelerated beam requires more careful measurement for confirmation. The column with beam has been operated thus far only to 370 kV with beam currents below 60 mA. Limitations have been imposed by inadequate pumping speed of an experimental titanium sublimation plus ion pumping system. Construction details of the column are shown in drawings and photographs. Also beam quality is indicated by fluorescent plate photographs. Author (NSA)

N67-24116# Midwestern Universities Research Association, Stoughton, Wis.
DUOPLASMATRON SOURCE PERFORMANCE AT MURA
J. A. Fasolo, C. D. Curtis, and G. M. Lee *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 371–382 refs Sponsored by AEC (See N67-24061 12-11)

A duoplasmatron with an expended plasma front and a Pierce-electrode extraction geometry has been under development at MURA since September, 1965. Modifications of expansion cup, magnetic aperture, plasma-defining aperture, intermediate electrode, and extraction geometries to increase beam current and improve beam quality are reviewed. A source point correction to emittance

estimates is derived. Emittance estimates, beam characteristic curves, and some results of mass analysis are presented and discussed. Results of a constant perveance experiment are given. A transition region in the beam characteristic curves is related to plasma boundary shape and beam quality. A magnetic field shaping experiment is discussed. Results of a bench test of the preaccelerator extractor and focus electrode geometry are presented. Author (NSA)

N67-24117# Brookhaven National Lab., Upton, N. Y.
BROOKHAVEN'S RECENT PRE-ACCELERATOR PROGRESS
Th. J. M. Sluyters *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 383–389 refs (See N67-24061 12-11)

The present linac pre-accelerator has been built to accelerate protons with intensities of milliamperes. In the present structure with a pre-focussing lens and an accelerating field of 6 kV/cm a maximum transparency of around 100 mA can be obtained. The performance of the beam, characterised by its brightness measured at 750 kV, is around 10^8 mA/cm^{2}rad^2, suggesting a minimum dilution in the tube of 20. This loss in brightness can mainly be caused by non-linear focussing in lens and accelerating regions. A careful redesign of the conventional low-gradient column can improve the brightness. A second possibility is a high gradient tube without pre-focussing. Theoretically the second solution is very attractive. However, it involves a high voltage technology just in its exploration status. Author (NSA)

N67-24119# Commissariat a l'Energie Atomique, Saclay (France).
A 100 mA ION BEAM WITH A LARGE BRIGHTNESS
P. Bernard, J. Faure, and R. Vienet *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 395–397 refs (See N67-24061 12-11)

A description is presented of a 350 keV preaccelerator used as a model for the construction of the 750 keV preinjector of the Saturne new injection line. The description includes ion source, beam extraction system, focusing lenses, and acceleration tubes. NSA

N67-24120# National Inst. for Research in Nuclear Science, Harwell (England). Rutherford High Energy Lab.
A NOTE ON SOME EMITTANCE MEASUREMENTS
H. Wroe *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 394 refs (See N67-24061 12-11)

Some preliminary results are described of an experiment in which an ion beam, from a duoplasmatron with geometry identical to the Brookhaven source, is accelerated to an energy of several hundred kV across a single gap. NSA

N67-24121# Los Alamos Scientific Lab., N. Mex.
THE "PIERCE" GEOMETRY: AN ACCELERATING COLUMN DESIGN
C. Robert Emigh *In its* Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 398–402 refs (See N67-24061 12-11)

The popular trend in today's design of accelerating columns is to make the field gradient near the extraction area as large as possible. The argument has been that if the proton beam energy can be brought up to the accelerator injection level in a very short distance, space charge has little time in which to act to increase the effective emittance by warping the emittance pattern. Support for this argument has come from the success of recently tested short columns in producing proton beams with low normalized emittances, in the region of 0.05 cm-milliradian. It is generally accepted that only the extraction system of Pierce is without aberrations. To emphasize these essential features of the Pierce extraction—coaxial flow, zero angular momentum, and a uniform density distribution—a derivation based on a zero effective emittance pattern throughout the acceleration is presented. Thus the recent successes in generating low emittance beams are probably the result of the Pierce-like geometries used by the column designer to implement his high gradient criteria rather than a result of the high gradient itself. The high gradient has the advantage of reducing the beam diameter to a manageable size for a given current. A simple integral equation for the field required outside the beam to support the Pierce geometry is derived. The equation is exact, based only on the 4/3 power law potential gradient at the beam boundary and on Laplace's equation outside the beam. Author (NSA)

N67-24122# Commissariat a l'Energie Atomique, Saclay (France).
DESIGN OF A 20 MeV PROTON LINEAR ACCELERATOR, NEW INJECTOR FOR SATURNE
M. Promé *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 403–409 refs (See N67-24061 12-11)

In order to increase the number of particles accelerated by the 3 BeV proton synchrotron SATURNE, it has been decided to replace its 3.6 MeV Van de Graaff injector by a 20 MeV linear accelerator. This accelerator is now being built. The main ideas which led to the design of this machine, and how the geometrical dimensions were chosen are discussed. Author (NSA)

N67-24123# Paris Univ., Orsay (France). Linear Accelerator Lab.
THE ORSAY LINAC Status Report
P. Brunet and L. Burnod *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 410–416 (See N67-24061 12-11)

The purposes of extending the performance (energy and current) of the linear accelerator at Orsay are discussed. The modifications to the existing linac are briefly summarized. NSA

N67-24124# Commissariat a l'Energie Atomique, Saclay (France). Department de Physique Nucleaire.
THE NEW HIGH DUTY CYCLE HIGH CURRENT 600 MeV ELECTRON–POSITRON LINEAR ACCELERATOR OF SACLAY
A. Sokolovsky *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 417–425 (See N67-24061 12-11)

The facilities of the new Saclay linear accelerator are described. The present status of its schedule is outlined. NSA

N67-24125# Commissariat a l'Energie Atomique, Saclay (France).
SOME CHARACTERISTIC PROBLEMS OF THE NEW HIGH DUTY CYCLE SACLAY ELECTRON LINAC
H. Leboutet, G. Azam, R. Bensussan, Blaise, Delmon et al *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 426–434 (See N67-24061 12-11)

The characteristic problems of the new high duty cycle Saclay electron linac are briefly outlined. The problems include choice of optimum rf power and length, mechanical, cooling, and beam blowup problems concerned with the sections, positron generator, beam injection, and stability. NSA

N67-24126# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy).
POSITRON ACCELERATION IN THE FRASCATI 450 MeV LINEAR ACCELERATOR
F. Amman, R. Andreani, J. Haimson, and C. Nunan (Varian Associates, Palo Alto, Calif.) *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 435–438 refs Prepared jointly with Varian Associates, Palo Alto, Calif. (See N67-24061 12-11)

A progress report is presented on the first results of beam testing on the Frascati 450 MeV positron linear accelerator. NSA

N67-24127# Compagnie Generale de Telegraphie sans Fil, Orsay (France).
RESULTS ON SOME EUROPEAN LINEAR ACCELERATORS
G. Azam and J. Milcamps *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 439–448 (See N67-24061 12-11)

The characteristics and performance of two European linear accelerators, Euratom linear electron accelerator and 300 MeV linear accelerator of Mainz (Germany), are discussed. NSA

N67-24128# Los Alamos Scientific Lab., N. Mex.
EIGHT HUNDRED AND FIVE MHz RF POWER SOURCES
D. E. Nagle *In its* Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 449–456 refs (See N67-24061 12-11)

The LASL linac design calls for a 201.25 MHz Alvarez linac followed by waveguide tanks operating at 805 MHz. There are to be 45 amplifiers with 1 MW output at 805 MHz. The amplifiers are described, with emphasis on the final power amplifier tube. NSA

N67-24129# Brookhaven National Lab., Upton, N. Y.
THE RF SYSTEM FOR THE AGS 200-MeV LINAC
J. Sheehan and R. Witkover *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 457–459 ref Sponsored by AEC (See N67-24061 12-11)

A new injector for the AGS will be built with a design output current of 100 mA at 200 MeV. A prototype rf system for this linac is being built as a basis for final design. A description of this system is given. Author (NSA)

N67-24130# Los Alamos Scientific Lab., N. Mex.
FAST RF CONTROL WORK AT LASL
R. A. Jameson, W. J. Hoffert, and N. A. Lindsay *In its* Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 460–466 refs (See N67-24061 12-11)

Fast closed loop control of rf phase and amplitude is necessary to maintain stable acceleration in the LAMPF proton linac. The results of a closed loop rf phase control system using a coaxitron power amplifier driving a full-scale accelerator structure are presented, demonstrating correction bandwidths greater than 200 kHz. Overall rf control system design and component development is discussed, and the proposed interplay between the fast rf control system and the central, digital computer based, machine control system is outlined. A review of current work to evaluate the control characteristics of various types of high-power rf amplifiers concludes the discussion. Author

N67-24131# California Univ., Berkeley. Lawrence Radiation Lab.
HIGH-DUTY-FACTOR CONVERSION OF THE BERKELEY HILAC
Bob H. Smith *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 467–470 Sponsored by AEC (See N67-24061 12-11)

A 6-MW dc power supply and a hard-tube modulator system has been installed at the Hilac to supply the anode power for the oscillators of the two linear accelerators. The pulse repetition rate and pulse width are variable. Most bombardments use a repetition rate of 40 pulses per second and pulse widths between 2 and 8 msec. The rf system and ion-source equipment were modified to handle the increased average power. Additional water cooling was applied to the linac tanks. The coupling line between the two tanks was removed and an electronic phase regulating system was installed. Improved rf amplitude regulators were developed and installed. Author

N67-24132# Los Alamos Scientific Lab., N. Mex.
COMPUTER CONTROL OF THE LAMPF ACCELERATOR
T. M. Putnam, H. S. Butler, and J. J. Smith *In its* Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 471–478 refs (See N67-24061 12-11)

A data acquisition and control system for the 800-MeV proton linear accelerator for the proposed Los Alamos Meson Physics Facility has been designed in depth on the premise that an on-line digital computer affords the best means of maintaining operational control over the machine. The three basic functions of any control system—data acquisition, display, and control—which were implemented with the aid of a computer are described. The system as presently designed has the capability for sampling any one of 63 analog or binary data channels at any of the 55 modules in the facility (or one channel from all 55 modules simultaneously). Similarly, the system can adjust any one of the 63 control channels at any or all modules. In addition, the system can select remotely any two video channels (of a possible 31 at each module) for display in the central control room. As an example of the speed of the system, it can sample and store in the computer's memory 10 binary status indications from each of the 55 modules in less than 250 microseconds. All information regarding the operational status of the accelerator is available to the operator on just two partial racks. The ability to adjust any control channel in the facility is provided on the same two racks. The system, which incorporates a versatile display scope, allows the operator to execute such varied and sophisticated tasks as steering the beam to compensate for misalignments of the accelerator, making phase space plots of the beam, and performing parametric studies of the effect of any control channel—all on-line. The concepts and operational procedures embodied in the LAMPF computer control system will be tested and evaluated in a series of experiments referred to as the mockup program. The status of the hardware to be used in this program is described. Author (NSA)

N67-24133# Stanford Univ., Calif. Linear Accelerator Center.
SOME EFFECTS OF (NOT HAVING) COMPUTER CONTROL FOR THE STANFORD LINEAR ACCELERATOR
K. B. Mallory *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 479–482 Sponsored by AEC (See N67-24061 12-11)

Amongst the original guidelines for the design of the control system for the Stanford Linear Accelerator was suitability for ultimate computer control of the accelerator. Although computer control has not materialized, this design influence has produced unusual features in the system. Video information was to be digested at the source and spoon-fed to the computer: the present system for bringing video signals to the central control room is very sketchy. Large special-purpose data recording systems were considered non-competitive with a small computer: there is now no automatic data-recording system. Sub-systems which are basically nothing but local switch-gear were to be fully implemented outside of central control: Central Control is only incidentally concerned with automatic phasing of the accelerator, personnel protection and beam shutoff interlock systems, and the automatic replacement of failed klystrons. Author

N67-24134# California Univ., Berkeley. Lawrence Radiation Lab.
DIGITAL CONTROL OF THE BEVATRON-INJECTOR INFLECTION TRAJECTORY
Robert W. Allison, Jr., Robert A. Belshe, Don M. Evans, Edward C. Hartwig, Henry D. Lancaster et al *In* LASL Proc. of the 1966 Linear Accelerator Conf. 1966 p 483–490 refs Sponsored by AEC (See N67-24061 12-11)

To minimize pickup jitter in the Bevatron, and to evaluate the digital control system proposed for the 200-BeV accelerator, a digital control on the Bevatron achromatic inflector was installed. A PDP-5 computer with interfacing provides 40 monitoring and 20 control channels. The interface communicates with the computer and the inflector system through time-division multiplexers. The system provides both automatic and manual control of the inflector deflection and focusing elements. Using the analog monitoring developed for beam control, the operating parameters of the inflection system were adjusted for maximum charge survival in the Bevatron. As a result, the injection efficiency increased by 30%. The beam position (at each monitoring station) was also set by using closed-loop digital control. Resonant induction electrodes are used to detect the center of gravity of the beam. Three-pulse convergence was obtained, with a resolution of ±0.1 mm. Author (NSA)

N67-24135# Stanford Univ., Calif. Dept. of Physics.
STANFORD'S SUPERCONDUCTING ACCELERATOR PROGRAM
T. I. Smith, H. A. Schwettman, W. M. Fairbank, and P. B. Wilson *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 491–493 refs (See N67-24061 12-11)
(Contract Nonr-225(67))

The progress of Stanford University's program to develop a useful superconducting electron linear accelerator is discussed. A description of the superconducting linac program and details of the ten foot test section are presented. NSA

N67-24136# Illinois Univ., Urbana.
PLANS FOR A SUPERCONDUCTING C.W. ELECTRON LINAC AT THE UNIVERSITY OF ILLINOIS
A. O. Hanson, D. Jamnik, C. S. Robinson, and C. L. Rogers *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 494–496 (See N67-24061 12-11)

A program to build an L band section, 15 feet long, which might be operated at 30 MeV and a CW accelerator of 400 MeV is discussed. The construction of a nitrogen shielded cryostat about 4 feet long into which can be mounted an L band section 3 wavelengths long, surrounded by liquid helium at temperatures down to 1.8°K, is described. NSA

N67-24137# Kernforschungszentrum, Karlsruhe (West Germany).
THE FEASIBILITY STUDY FOR A SUPERCONDUCTING LINEAR ACCELERATOR FOR PROTONS Status Report
A. Citron *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 497–498 (See N67-24061 12-11)

A study into the possibility of designing a superconducting proton linear accelerator operating CW and giving between 10 and 100 μA of protons is discussed. NSA

N67-24138# Kernforschungszentrum, Karlsruhe (West Germany).
THE PREPARATION AND PERFORMANCE OF SUPERCONDUCTING CAVITIES
P. Flecher, J. Halbritter, R. Hietschold, and K. Hofmann *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 499–501 (N67-24061 12-11)

Three methods were used to produce superconducting cavities: electroplating, electroless deposition, and evaporation. The Q-value of the structures was measured using the decrement method. NSA

N67-24139# Kernforschungszentrum, Karlsruhe (West Germany).
AN INVESTIGATION OF THE SLOTTED IRIS STRUCTURE WITH DRIFT TUBES
H. Eschelbacher and H. Schopper *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 502–507 refs (See N67-24061 12-11)

In order to obtain a systematic optimization of the slotted iris structure measurements were performed with demountable models consisting of three or six cells. The measurements were resonance frequencies for all modes, Q-values for all modes, and effective shunt impedance for the π-mode. The influence of geometrical parameters was investigated for different cell lengths. NSA

N67-24140# Paris Univ., Orsay (France). Nuclear Physics Inst.
A ONE MeV/NUCLEON HEAVY ION LINEAR ACCELERATOR
C. Bieth, A. Cabrespien, Ch. Goldstein, J. Bosser, and J. Arianer *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 508–510 refs (See N67-24061 12-11)

The ion source, accelerating cavity, and focusing system of the heavy ion linear accelerator which is being constructed at Orsay are discussed. NSA

N67-24253# Battelle Memorial Inst., Columbus, Ohio.
A CUSTOM METALLOGRAPHIC POLISHING TABLE
R. D. Buchheit *In* Rocky Flats Div., Dow Chemical Co. Advan. in Metallog. 20 Oct. 1966 p 92–96 (See N67-24241 12-17)

A special metallographic polishing table, primarily suited for a large metallography laboratory, is described. The table features 16 polishing wheels, both variable and high speed; chemical hoods; compressed air; single sump; compactness; and easy maintenance. Author

N67-24256# Union Carbide Corp., Oak Ridge, Tenn. Nuclear Div.
A BASIC METALLOGRAPHIC LABORATORY FILING AND DATA HANDLING SYSTEM
G. L. Dadisman *In* Rocky Flats Div., Dow Chemical Co. Advan. in Metallog. 20 Oct. 1966 p 109–117 (See N67-24241 12-17)

As the total volume of metallographic samples and data increases because of time and internal growth, the importance of an efficient filing and work control system becomes apparent. A basic system is described which may be useful to the typical production metallographic laboratory in work control and filing of samples, negatives, prints, replicas, and miscellaneous data. Author

N67-24278# Boeing Co., Seattle, Wash.
SIMULATED WEIGHTLESSNESS UNDER NEUTRAL BUOYANCY
Robert D. Dean and Robert P. Langan *In* NASA. Marshall Space Flight Center Proc. of the Interdisciplinary Symp. on Apollo Appl. Programs, 12–13 Jan. 1966 Dec. 1966 p 229–240 refs (See N67-24268 12-30)

Limitations and advantages of the new neutral buoyancy zero-gravity simulation technique are discussed, and studies conducted in neutrally buoyant environments which were designed to evaluate the potentiality of this technique are reviewed. Reported are results of studies of the effects of neutral buoyancy on the time required to traverse 20- and 28-inch circular hatches; the effects of neutral buoyancy on man's ability to manipulate hand tools such as wrenches and screw drivers; the extravehicular assembly; restraint concepts; and a prototype airlock design. It is concluded that in spite of the inherent limitations of neutral buoyancy, the method can provide an inexpensive and reliable means of evaluating designs for space vehicle hatches, compartments, airlocks, restraints, and transfer devices; and can also provide an invaluable training aid, in that it permits practice on performance in an environment that approximates true zero gravity. S.C.W.

N67-24443# Arbeitsgruppe Biophysikalische Raumforschung, Frankfurt am Main (West Germany).
SIMULATION CHAMBERS FOR BIOPHYSICAL RESEARCH AND THEIR PROBLEMS [SIMULATIONSKAMMERN FUER BIOPHYSIKALISCHE UNTERSUCHUNGEN UND IHRE PROBLEME]
W. Huber and H. Woessner *In its* Extraterrest. Biophys. and Biol. [1966] p 135–139 refs (See N67-24424 12-04)

Described are construction of instrumentation of ultrahigh vacuum chambers for biological experiments. Cryogenic insulation of the complete apparatus is recommended to avoid heating to about 400°C in order to obtain the ultrahigh vacuum. Quartz or sapphire windows are used to transfer electromagnetic radiation into the vacuum, and an oil diffusion pump and vacuum lock keep the proper vacuum and provide an entrance for biological probes. A proper combination of diffusion pumps with vapor traps, ion getter pumps, molecular pumps, and cryogenic pumps with a corresponding preparation of the vacuum system chamber makes it possible to obtain pressures of about 10^{-10} Torr. Transl. by G.G.

N67-24445# Arbeitsgruppe Biophysikalische Raumforschung, Frankfurt am Main (West Germany).

ON THE SIMULATION OF SOLAR RADIATION AND ITS EFFECTS ON BIOPHYSICAL VISION [ZUR SIMULATION DER SONNENSTRAHLUNG AUS BIOPHYSIKALISCHER SICHT]

Winfried Voelker *In its* Extraterrest. Biophys. and Biol. [1966] p 145–154 (See N67-24424 12-04)

Solar radiation simulation for biophysical observations requires optical intensities that activate photolytic and photosynthetic reactions at quantum energy values corresponding to excitation, activation, ionization, and bonding energies of biological samples. The short wave portion of the spectrum is of special interest for extraterrestrial solar radiation simulation because of its absorption wavelength and its specific effects. Ultra soft X-rays, hydrogen arc discharge, and mercury arc discharge are the foremost sources for this simulation. Transl. by G.G.

N67-24446# Arbeitsgruppe Biophysikalische Raumforschung, Frankfurt am Main (West Germany).

CHARACTERISTICS OF RADIATION FROM EMISSION LAMPS USED FOR SOLAR SIMULATION [STRAHLUNGS-EIGENSCHAFTEN VON ENTLADUNGSLAMPEN ZUR SONNENSIMULATION]

W. Muench *In its* Extraterrest. Biophys. and Biol. [1966] p 155–158 (See N67-24424 12-04)

High pressure xenon arc lamps are effective solar radiation simulators for biophysical and biological space research because their arc density and spectrum corresponds very much to solar energy. Radiation sources of high density and with line emission are mercury arc lamps; these are especially applicable to optical studies of subsystems and for obtaining effective spectra of manochromators. Xenon long-arc lamps are usefull in bioclimatical studies of plants and animals because of their similarity with solar spectral density distribution. Transl. by G.G.

N67-24598 European Atomic Energy Community, Karlsruhe (West Germany). Joint Nuclear Research Center.

PROCESS CELL AND EQUIPMENT FOR TRANSPLUTONIUM ISOLATION AT KARLSRUHE

W. Mueller Brussels, EURATOM, Feb. 1967 22 p refs Presented at the Intern. Transplutonium Elements Symp., Oak Ridge, Tenn., 8–10 Nov. 1966

(EUR-3273.e) CFSTI: $3.00

Shielded cells were prepared for the processing of transplutonium targets. The equipment designed for this processing is described. Author

N67-24618*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

COOLDOWN CHARACTERISTICS OF REGENERATIVE NOZZLE USED IN FULL-SCALE, COLD-FLOW, NUCLEAR ROCKET TEST FACILITY

George E. Turney and Eileen Cox Washington, NASA, May 1967 60 p refs

(NASA-TN-D-3931) CFSTI: HC $3.00/MF $0.65 CSCL 14B

The pressure drops and heat transfer rates with gaseous, two-phase, and subcooled liquid hydrogen flow in the nozzle assembly were computed and compared with experimental measurements. The results show that the time constant for the chilldown of the nozzle is extremely small. For the startup test run presented herein, the coolant-tube temperatures near the nozzle tube inlet were reduced from approximately 510° to 50°R in the first 4 seconds of the startup transient. Except for local inflections in some of the measured temperatures (caused by unstable two-phase boiling), the calculated material temperatures for the convergent segment of the nozzle tubes were within, or reasonably near, the experimental accuracy of the measured material temperatures. The largest relative differences in predicted and measured local coolant-tube temperatures occurred at locations on the divergent length of the nozzle tubes during the two-phase flow and liquid flow periods of the test run. During the time span in which the two-phase hydrogen flow mixture was predominately liquid, the calculated pressure drops were considerably larger than the measured values. A possible explanation of this difference is that the Martinelli relations, which were used in the pressure-drop analysis, tend to overestimate the frictional loss for two-phase hydrogen flow, particularly when the two-phase flow mixture is predominately liquid. Author

N67-24625*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

DESIGN AND FABRICATION OF NONCONDENSING RADIATOR FOR ENVIRONMENTAL EVALUATION OF SPACE POWER MERCURY RANKINE SYSTEM

John W. Cox, Harold H. Greenfield (Lockheed Missiles and Space Co., Sunnyvale, Calif.), William T. Wintucky, and Lawrence A. Mueller Washington, NASA, May 1967 32 p refs

(NASA-TM-X-1372) CFSTI: HC $3.00/MF $0.65 CSCL 13A

Three phases of work on a waste-heat ground test radiator are presented: conceptual design, mechanical design, and fabrication. Based on restrictions of a vacuum chamber test facility and optimization through the use of a digital computer program, a physical configuration was determined. Construction of the radiator (1000 sq ft outside radiating surface, 40 ft long, 8 ft diam, and 40 finned tubes) was of semimonocoque design for minimum weight and ease of handling. The finned tube construction consisted of 0.015-inch-wall 316 stainless steel tubing covered by 0.062-inch-thick 3003 aluminum alloy with diametrically opposite fins of the same aluminum material and thickness. Preformed aluminum panels and tubes were metallurgically joined by more than 1/3 mile of brazed joint. Photographs showing the brazing techniques developed by the fabricator, including the thermal emissivity coating procedure, are included along with the fabrication procedure. Author

N67-24666# Joint Inst. for Nuclear Research, Dubna. Lab. of High Energy.

RESONATOR OF A PROTON MULTIPLE ACCELERATION SYSTEM IN THE JINR SYNCHROPHASOTRON

V. A. Vagin, V. D. Volodin, A. P. Saenko, I. N. Semenyushkin et al 1966 13 p In RUSSIAN

(JINR-P13-3084) CFSTI: HC $3.00/MF $0.65

A design of the multiple acceleration system resonator is chosen. The main parameters are calculated. The methods of depression of a resonance high-frequency division in vacuum $3 \cdot 10^{-6}$ mm Hg without magnetic field and in the presence of a scattered magnetic field $H_2 \approx 50$ Oe are described. The results of testing this resonator in the JINR synchrophasotron accelerator are described. Author (NSA)

N67-24720# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

NONFERROUS ACCELERATOR OF CHARGED PARTICLES

Ye. A. Abramyan, G. I. Budker, and A. A. Naumov 5 Dec. 1966 6 p Transl. into ENGLISH from Russian Patent No. 168908 (Appl. no. 829694/26-25, 8 Apr. 1963) 2 p

(FTD-HT-66-603; AD-646930) CFSTI: HC $3.00/MF $0.65

A nonferrous charged-particle accelerator that contains a vacuum chamber, resonator, injector, and current-conducting buses is described. It is distinguished by the fact that an equalizing central bus is used to accelerate particles of the same sign in opposite directions. The accelerator is designed in the form of a nonsymmetrical racetrack to assure the intersection of particle beams. Author (TAB)

N67-24743# Air Force Missile Development Center, Holloman AFB, N. Mex.
WIND TUNNEL AND FULL SCALE FORCE ON ROCKET SLEDS
Daniel J. Krupovage, Larry C. Mixon, and Otto T. Pokorny Jan. 1967 58 p refs
(MDC-TR-67-12; AD-647064) CFSTI: HC $3.00/MF $0.65

Vertical quasi-steady state forces on three dual rail rocket sleds, which were predicted using wind tunnel data, are compared with those measured on the Holloman Test Track. A description of the magnitude and character of the oscillatory forces is also presented. This is the first such comparison since the advent of rocket sled testing. Wind tunnel force tests on the three rocket sleds indicated that aerodynamic forces would be of sufficient magnitude to warrant consideration in structural design. The forces measured during the track tests indicated that the aerodynamic contribution was the dominant component to the vertical quasi-steady state force in the supersonic regime. The results of full-scale investigations showed implicitly that when the sleds experienced considerable aerodynamic forces, the wind tunnel data agreed fairly well with the forces measured on the rocket sled. The quasi-steady state vertical forces were predicted, using wind tunnel data, to within 3,000 pounds for loads between 12,000 and 32,000 pounds.
Author (TAB)

N67-24901# Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Aero Propulsion Lab.
ANALYTICAL STUDY OF SHOCK TUNNEL SIMULATION OF COMBUSTOR ENTRANCE CONDITIONS
Harold F. Chambers, Jr. Oct. 1966 40 p refs
(AFAPL-TR-66-82; AD-646599) CFSTI: HC $3.00/MF $0.65

In order to study the simulation capability of the shock tunnel, a set of combustor entrance conditions was generated from a 10-degree, two-shock wedge inlet and a trajectory of 1250 psf. These were compared with shock tunnel calculations for a 15-degree half-angle conical nozzle, a 5-degree half-angle conical nozzle, and a 5-degree 2-dimensional nozzle. The matching of pressure, temperature, velocity, and composition was studied. The composition deviation in the shock-tunnel nozzle was examined for its effect on hydrogen combustion ignition delay time.
Author (TAB)

N67-24938# Naval Air Development Center, Johnsville, Pa.
EXPERIMENTAL DESIGN FOR IHAS AVIONIC SYSTEM SIMULATION
V. E. Lafranchi 2 Dec. 1966 21 p
(NADC-AM-6671; AD-647166) CFSTI: HC $3.00/MF $0.65

The purpose of the experimental design is to set up a method to validate the prime contractor's man-machine interface proposals. Also, a quantitative measure of pilot performance on the cockpit displays employed in the IHAS System Simulation is to be obtained. One hundred twenty-eight laboratory simulated flights are to be flown and errors from presecibed flight path are to be recorded on magnetic tape.
Author (TAB)

N67-25005*# National Aeronautics and Space Administration, Washington, D. C.
THE O.N.E.R.A. TESTING METHODS AND THEIR RECENT PROGRESS [LES METHODS D'ESSAIS HYPERSONIQUES DE L'O.N.E.R.A. ET LEURS PROGRES RECENTS]
P. Carriere Apr. 1967 28 p refs Transl. into ENGLISH from the Paper Presented at the Colloq. on Hypersonic Aerodyn. and Study of High-Speed Phenomena Tech., St. Louis, France, 14–15 Jun. 1966
(NASA-TT-F-10861) CFSTI: HC $3.00/MF $0.65 CSCL 14B

Some O.N.E.R.A. hypersonic testing facilities, and conventional long run duration facilities for $2<M<10$ with emphasis on the R3 wind tunnel ($8<M<10$) useful for heating research (i.e. rocket stage separation, hypersonic air intakes, etc.) are described. The slow compression R4 wind tunnel for $M=14$ and the hot shot wind tunnel for $(15<M<20)$ are also described. Frozen flow phenomena at the nozzle throat and their effects are also given.
Author

N67-25007* National Aeronautics and Space Administration, Washington, D. C.
SCHLIEREN AND HOT WIRE EXPLORATION OF WAKES IN WIND-TUNNEL SUPERSONIC FLOWS [OBSERVATIONS EN SOUFFLERIE DE SILLAGES DANS UN ECOULEMENT SUPERSONIQUE PAR STRIOSCOPIE ET ANEMOMETRIE A FIL CHAUD]
J. Gaviglio and H. Burnage Apr. 1967 36 p refs Transl. into ENGLISH from the Paper Presented at the 3d A.F.I.T.A.E. Colloq. on Appl. Aerodyn., Marseille, 8–10 Nov. 1966
(NASA-TT-F-10860; ONERA-TP-417) CSCL 14B

Methods of observation of turbulent flows are described in the first part; they are justified by a brief survey of the theories of which they are founded. The advantage of calibrating the anemometers in the conditions of measurement is shown. The measurement equipment is described. Some examples of application to the case of wakes are given. It is also shown how the methods described allow an analysis of the characteristics of these flows as a function of various parameters.
Author

N67-25065*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
FACILITY ENGINEERING AND OPERATIONS
In its Space Programs Sum. No. 37–44, Vol. III 31 Mar. 1967 p 112–127 (See N67-25061 12-07)

Ground support equipment, operations, testing, and facilities are described for the deep space network programs. Flight support for the various space projects, and facility generator and antenna construction and installation are reviewed. Experimental activities and subsystem performance in connection with the Venus deep space station operations, and DSIF station control and data equipment are reported. The 12-week utilization schedule is outlined, and the 7-day and 16-month loading schedules are mentioned. The design and operation of a star clock to be used in antenna calibrations are described, and it is felt that the device will be useful in selecting suitable stars for tracking.
N.E.N.

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N67-23633# Naval Scientific Technical Information Center, London (England).
ANALYTICAL SOLUTION OF THE INTEGRAL EQUATION OF THE OSCILLATIONS OF THIN PROFILES IN CASCADE
V. P. Vakemchik Nov. 1966 9 p refs Transl. into ENGLISH from Inzh. Zh. (USSR), v. 5, no. 3, 1965 p 555–560
(NSTIC-Trans.-1832; NSTIC/09172/66; AD-646093) CFSTI: HC $3.00/MF $0.65

In the author's previous paper (The problem of determining unstable forces in a cascade of airfoils, Inzh. Zh., 1, 5, (1965)), general expressions for the lift force, momentum, suction force - acting on the oscillating profiles (airfoil blades) in cascade - were obtained in the form of four addends. Two of these addends are determined by values of tangential components of velocity u(xi) - which is an unknown function - in wakes of the airfoils (profiles) in cascade. For calculation of function u(xi), the Volterra integral equation was derived. In the present work, an analytical solution of this integral equation and the unknown tangential component of velocity u(xi) are given.
TAB

N67-23658*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
FLUID PHYSICS
In its Supporting Res. and Advanced Develop. 28 Feb. 1967 p 277–286 refs (See N67-23641 12-11)

Three-dimensional viscous disturbances at finite Reynolds numbers are calculated from two-dimensional linear stability theory, and deficiencies are noted when the existing computer program for the sixth-order system of equations is used for three-dimensional disturbances. Interpretation of the Dunn–Lin version of the Squire transformation is considered, an experiment is being conducted in a low density wind tunnel to examine the structure of normal shock waves in one-dimensional helium–argon flows, and the dependence of experimental species thickness on mixture ratio is being investigated. Magnetohydrodynamic experiments with large interaction parameters are being studied, and magnetic and velocity fields aligned far upstream of a body placed in the flow are discussed. M.W.R.

N67-23694# Rutgers Univ., New Brunswick, N. J. Dept. of Mechanical and Aerospace Engineering.
SOME STATISTICAL TURBULENCE PROPERTIES OF THE FLUID PHASE IN A GAS SOLID SUSPENSION
Richard L. Peskin and John P. Wallace Sep. 1966 126 p refs
(Contract AT (30-1)-2930)
(TR-112-ME-F; NYO-2930-9) CFSTI: HC$3.00/MF$0.65

The longitudinal intensity of turbulence and the longitudinal spectra of the suspension fluid were measured by means of a glow discharge probe in a 3" square duct. For a mean velocity of 85 FPS and a solids loading ratio of .465 pounds of .0058" dia glass beads per pound of air, the intensity at the center of the duct is shown to decrease. Upon introduction of the particles the spectra of the fluid shows a modulation effect in which the energy density at low frequencies is decreased and the energy density at high frequencies is increased. An analysis of the high wave-number regime using the Pao transfer function and assuming that the particles produce a uniformly distributed volume force described by the Stokes drag predicts the behavior of the measured spectra.
Author (NSA)

N67-23715*# Oklahoma State Univ., Stillwater.
ANALYTICAL INVESTIGATIONS OF LAMINAR SEPARATIONS USING THE "CROCCO–LEES MIXING PARAMETER" METHOD
D. R. Haworth and A. R. Peters Washington, NASA, May 1967 51 p refs
(Grant NGR-37-002-028)
(NASA-CR-745) CFSTI: HC $3.00/MF $0.65 CSCL 20D

The design of advanced high-speed aircraft has prompted considerable interest in supersonic and hypersonic boundary layer separation problems. A review of the current analytical methods and available experimental data has been made for the two-dimensional flat plate-deflected flap configuration. The semi-empirical approach initially proposed by Crocco and Lees and as subsequently modified was used in the study. Improvements in the understanding of the mixing function correlation through the initial separation point and up to the plate–flap intersection have been presented. The necessity for coupling together the complete separated region from initial separation to final reattachment has been indicated. Author

N67-23733# General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.
ISOKINETIC SAMPLING PROBE TECHNIQUE: APPLIED TO TWO-COMPONENT, TWO-PHASE FLOW
F. A. Schraub Nov. 1966 45 p refs
(Contract AT(04-3)-189)
(GEAP-5287) CFSTI: HC$3.00/MF$0.65

Isokinetic sampling provides local time-average values of gas velocity, liquid velocity, void fraction, and quality in two-phase flow. The isokinetic sampling technique as applied to adiabatic, incompressible, two-component, gas-liquid flow is described. Limitations and problems in technique, typical results, and operating experience with small diameter probes (sampling diameters near 0.03 inch) are emphasized. The technique consists of experimental determination of local flow rates and impact pressure and analysis to relate these experimental results to local void fraction. Experimental procedures and problems are discussed at length. The results of different analyses are compared and a preferred data reduction procedure is recommended. Author (NSA)

N67-23824# Texas Univ., Austin. Defense Research Lab.
SEPARATION MEASUREMENTS OF SUPERSONIC TURBULENT BOUNDARY LAYERS OVER COMPRESSION CORNERS
Walter B. Gillette 21 Jul. 1966 111 p refs Prepared for APL
(DRL-543; CR-26; AD-644194) CFSTI: HC$3.00/MF$0.65

To the designer of modern high-speed aerospace vehicles, separation of the boundary layer before macroscopic surface features is an important problem. A typical feature of interest is a compression corner, or ramp. To aid in the development of comprehensive theories concerning boundary layer separation before a compression corner, a series of experimental investigations were conducted for the adiabatic flow of a supersonic compressible gas over a compression corner. Tests were conducted at free-stream Mach Numbers of 2.00 to 4.00 in increments of 0.50, at flat plate Reynolds Numbers of 0.75 x 10 to the 7th and 1.5 x 10 to the 7th, and for compression angles of 10.3 deg, 20.1 deg, 30.5 deg, and 39.9 deg. Static pressure surveys of the flow ahead of and over the compression corner were made. These measurements were supplemented by high-speed schlieren photographs and shadowgraphs. The separation of the turbulent compressible boundary layer was found to have strong dependence on both the Mach Number and the Reynolds Number. For Mach Numbers less than 3.00, the separation distance ahead of the compression corner decreased with increasing Mach Number. For Mach Numbers of 3.50 and 4.00, the separation distance increased with Mach Number. At all Mach Numbers, an increase in Reynolds Number increased the separation distance. The Reynolds Number influence was greater at the higher Reynolds Numbers. Unsteadiness in the separation geometry occurred for separation distances greater than six or eight boundary layer thicknesses. The separation was found to result from a free interaction of the flow phenomena involved.
Author (TAB)

N67-23854*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
INVESTIGATION OF METHODS FOR PREDICTING FLOW IN THE SHOCK LAYER OVER BODIES AT SMALL ANGLES OF ATTACK
William F. Gallo and John V. Rakich Washington, NASA, May 1967 88 p refs
(NASA-TN-D-3946) CFSTI: HC$3.00/MF$0.65 CSCL 01A

Two theoretical methods for predicting the flow field about axisymmetric bodies at small angles of attack are studied. The methods, the linearized characteristics method and the equivalent body method, are compared with experimental data for a blunted cone, an ogive cylinder, and an X-15 airplane model. Each theory was found superior in certain flow regions, neither being superior in all cases. The linearized characteristic theory was found to be useful for predicting the flow fields about bodies of higher fineness ratio, such as an ogive cylinder and the X-15 at small angles of attack. The equivalent body method agreed well with experiment in blunt nose region and in regions further downstream dominated by the effects of the blunt nose (about 16 radii). The equivalent body method, however, is restricted in the present report to the plane of flow symmetry. Additional theoretical predictions of parameters of interest to the X-15 flight test program are included. The parameters investigated are local Mach number, flow angle, and

pitot pressure for three different free-stream Mach numbers and at angles of attack up to 10°. Author

N67-23867# Pennsylvania State Univ., University Park. Dept. of Aeronautical Engineering.
AN EXPERIMENTAL STUDY OF GRID TURBULENCE IN DILUTE HIGH-POLYMER SOLUTIONS
Andrew G. Fabula Jun. 1965 315 p refs
(Grant Nonr(G)-00043-65)
(AD-640148) CFSTI: HC $3.00/MF $0.65

The aim of this study was to determine the effects upon the longitudinal, one-dimensional energy spectrum in grid turbulence of the non-Newtonian properties produced by low concentrations of high molecular weight polymers dissolved in water. By studying an approximately isotropic turbulence, in which the experimental effects of the non-Newtonian properties of the solution might be most easily correlated with theory, it was intended to contribute to the eventual understanding of the mechanism of the friction reduction which the test solutions typically show in turbulent shear flows in pipes and boundary layers. A 48-foot towing tank, with cross-section of 48 by 45 inches, was constructed and equipped for grid-turbulence measurements in water and aqueous solutions and suspensions. The experimental procedure was to tow a vertical grid along the tank, followed by a turbulence sensor moving at the same speed as the grid. The grid was towed at a standard speed of 36.2 cm/s. The grid form was chosen to allow a correlation of the results in water with grid turbulence measurements in air. The mesh width was 11.8 cm. The grid Reynolds number, RM, was roughly 40,000 and the turbulence Reynolds number, RL, was about 500. TAB

N67-23999 Royal Greenwich Observatory, Herstmonceux (England).
DYNAMICS OF SELF-GRAVITATING GASEOUS SPHERES, I. THE COLLAPSE OF AN ISOTHERMAL GAS SPHERE
M. V. Penston London, HMSO, 1966 16 p *Its* Royal Observatory Bull. No. 117
HMSO: 2s 6d

The collapse of an isothermal gas sphere is followed out of the regime where a linear approximation is valid by integrating the full equations of hydrodynamics by a numerical method. This is used to provide models for the collapse of gaseous spheres to form a star cluster, and a galaxy or quasar. The results are expressed in terms of a number of graphs. The most striking feature is that the collapse develops most rapidly in the central (densest) regions. The efficacy of the numerical method is discussed and the desirability of extending it to cases other than the isothermal is expressed. Author

N67-24001# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE THEORY OF STRONG INTERACTION BETWEEN A BOUNDARY LAYER AND A HYPERSONIC INVISCID FLOW
N. S. Matveyeva and V. V. Sychev 14 Jul. 1966 23 p refs Transl. into ENGLISH from Prikl. Mat. i Mekh. (Moscow), v. 29, no. 4, 1965 p 644–657
(FTD-HT-66-299; TT-67-60681; AD-646288) CFSTI: HC $3.00/MF $0.65

The purpose of the work is to construct an asymptotic solution of these equations that corresponds to uniform motion of a gas behind a shock wave that is spreading. TAB

N67-24048# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
THERMALLY INDUCED BOUNDARY-LAYER FLOWS IN A ROTATING ENVIRONMENT
Norman Riley Oct. 1966 37 p refs
(Contract AF 49(638)-1274)
(SUDAAR-292; AFOSR-66-2335; AD-646045) CFSTI: HC $3.00/MF $0.65

Boundary-layer flows induced by heating fluid which is initially in an isothermal rigid-body rotation are studied. Cases considered are (i) fluid bounded on one side by a rotating plane whose temperature is impulsively changed or is varied sinusoidally (ii) fluid bounded by two rotating planes whose temperatures are impulsively changed by the same amount. Author (TAB)

N67-24057# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.
STABILITY OF SHEAR FLOWS OVER RIGID OR FLEXIBLE SURFACES Final Summary Report
E. Mollo-Christensen and M. Landahl Nov. 1966 4 p refs
(Contract Nonr-1841(89))
(ASRL-TR-116-5; AD-645022) CFSTI: HC $3.00/MF $0.65

A review of theoretical and experimental investigations is presented. Nine papers on the subject are listed. TAB

N67-24145 Polish Academy of Sciences, Warsaw. Institute of Basic Technical Problems.
PROPAGATION OF AN ACOUSTIC WAVE IN A NON-NEWTONIAN VISCOUS LIQUID
A. Opilski *In its* Proc. of Vibration Probl., Vol. 7, No. 4 1966 p 329–335 refs (See N67-24141 12-23)

In considerations concerning the propagation of an acoustic wave, the relation between the strain rate tensor and the viscous stress tensor is usually assumed to be linear, although the linearity condition is not always satisfied. A study is made of the influence of a deviation from the linearity of the relations between the strain rate and viscous stress tensors on the propagation of the acoustic wave and the formulation of criteria decisive as to whether the body shows a deviation from linearity. A quadratic relation between the tensors is considered. Author

N67-24158# Los Alamos Scientific Lab., N. Mex.
FINITE DIFFERENCE METHODS OF SOLUTION OF NONLINEAR FLOW PROCESSES WITH APPLICATION TO THE BENARD PROBLEM
Jacob E. Fromm 4 Jan. 1967 135 p refs
(Contract W-7405-ENG-36)
(LA-3522) CFSTI: HC $3.00/MF $0.65

A general method of numerical calculation of compressible flows is outlined in which such flows are divided into irrotational and solenoidal parts. The general equations are reduced to the Boussinesq approximation for consideration of the Bénard problem. The Bénard problem, both in method of solution and result, is used to analyze a number of crucial aspects of finite difference calculation. In particular, the nonlinear formulations in current use are developed and related in a systematic way; and, in addition, some higher order methods are derived. Examples of the time-dependent behavior of the thermal convection problem are examined for physical interpretation in terms of gross property measurements and character of instaneous solutions with the hope that the experience so gained will be valuable to extensions of the numerical method to more general problems. Author(NSA)

N67-24196# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
SUPERSONIC FLOW ABOUT BLUNT BODIES OF REVOLUTION WITH A CORNER [SVERKHZVUKOVOE OBTEKANIE ZATUPLENNYKH TEL VRASHCHENIYA S IZLOMOM OBRAZUYVSHCHEI]
D. M. Belotserkovskii, E. S. Sedova, and F. V. Shugaev Mar. 1967 16 p refs Transl. into ENGLISH from Zh. Vychislitel'noi Mat. i Mat. Fiz. (Moscow), v. 6, Sep.–Oct. 1966
(TR-42) CFSTI: HC $3.00/MF $0.65

A solution is presented to the problem of calculating a supersonic flow about a blunt body with a corner determining the sonic point on the body. Consideration is given to the case of the flow at the corner reaching the local sound velocity; the shape of the body behind the corner does not influence the subsonic flow near the nose. The solution is found in the region bounded by the body surface, the shock wave, the axis of symmetry, and the limiting characteristics. The basic system of gas dynamics equations, consisting of the continuity equation and the equations of motion, are written in divergence form. The method of integral relations, in which the gas dynamic functions are approximated, it also applied. M.G.J.

N67-24228# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.

ON ONE SCHEME OF THE METHOD OF INTEGRAL RELATIONS IN THE PROBLEM OF SUPERSONIC FLOW OVER A BLUNT BODY [OB ODNOI SKHEME METODA INTEGRAL'NYKH SOOTNOSHENII V ZADACHE O SVERKHZVUKOVOVOM OBTEKANII ZATUPLENNYKH TEL]

F. D. Popov Nov. 1966 19 p refs Transl. into ENGLISH from Zh. Tekhn. Fiz. (Leningrad), v. 34, no. 2, 1966

(TR-37) CFSTI: HC$3.00/MF$0.65

It is proposed, in the method of integral relations, to carry out the simultaneous approximation of functions in two directions. The initial system of partial differential equations in the two-dimensional case is replaced by an approximating system of transcendental algebraic equations. As an example the calculation of the flow over a sphere by a supersonic stream of a perfect gas with constant heat capacity ($\gamma = C_p/C_v = \text{const}$) is carried out on the basis of the proposed scheme over a wide interval of M_∞ and γ. Author

N67-24230# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.

ASYMPTOTIC SOLUTIONS OF THE NAVIER–STOKES EQUATIONS IN REGIONS WITH LARGE LOCAL PERTURBATIONS [ASIMPTOTICHESKIE RESHENIYA URAVNENII NAV'YE–STOKASA V OBLASTYAKH BOL'SHIMI LOKAL'NYMI VOZMUSHCHENIYAMI]

V. Ya. Neiland and V. V. Sychev Mar. 1967 20 p refs Transl. into ENGLISH from Mekhan. Zhidkosti Gaza (USSR), no. 4, 1966

(TR-40) CFSTI: HC$3.00/MF$0.65

The problem of viscous supersonic flow near a wall with large local surface curvature is examined. Certain general properties of asymptotic solutions of the Navier–Stokes equations for the characteristic Reynolds number of the problem tending to infinity, are investigated. A technique of constructing and matching the sets of asymptotic expansions, which represents the solutions in different characteristic regions of the flow, is applied for viscosity tending to zero. L.S.

N67-24238# Michigan Univ., Ann Arbor. Dept. of Physics.

THE METHOD OF AVERAGING. THE KINETIC EQUATION FOR MODERATELY DENSE GASES

George Ford *In* Brookhaven Natl. Lab. Summer Inst. on Spectral Theory and Statist. Mech., 1965 Nov. 1966 p 222–263 refs (See N67-24231 12-19)

Differential equations outlining the method of averaging; and examples showing how the method works and might be useful in solving physics problems, are presented. A detailed application of the method to derivation of a kinetic equation for moderately dense gases is then given. The problem involves determining the corrections to the Boltzmann kinetic equation. The analysis involves the particle distribution functions, the gas particle mass, the differential scattering cross section for a collision between two atoms, and the density of the gas. Some formal properties of mechanical motion are considered; and a method of expressing the partial distribution functions formally in terms of their values, and to eliminate the initial values to obtain a single equation for the distribution function, is discussed. A sequence of dynamical equations for the gas particle motion is also given. L.S.

N67-24274# Wyle Labs., Inc., El Segundo, Calif.

MATHEMATICAL ADVANCES IN THE THEORY OF ONE DIMENSIONAL FLOW

Ervin Y. Rodin *In* NASA. Marshall Space Flight Center Proc. of the Interdisciplinary Symp. on Apollo Appl. Programs, 12–13 Jan. 1966 Dec. 1966 p 143–160 refs (See N67-24268 12-30)

This paper contains the derivation of a Burgers' equation, as a definite approximation of high order, from the one dimensional Riemann pair of equations (with a viscous term) which is a description of the motion of waves of finite amplitude. The solution of the Cauchy problem for Burgers' equation is presented, together with a discussion of solutions by means of infinite products. Author

N67-24449*# Scientific Translation Service, La Canada, Calif.

DIFFERENCE METHODS OF SOLVING THREE-DIMENSIONAL PROBLEMS IN GAS DYNAMICS [RAZNOSTNYYE METODY RESHENIYA PROSTRANSTVENNYKH ZADACH GAZOVOY DINAMIKI]

K. I. Babenko and V. V. Rusanov Washington, NASA, Apr. 1967 19 p refs Transl. into ENGLISH from "Kolebaniya, Giroskopiya, Teoriya Mekhanizmov, Mekhanika Zhidkosti i Gaza" Moscow, Nauka Publishing House, 1965 p 247–262

(Contract NASw-1496)

(NASA-TT-F-10827) CFSTI: HC$3.00/MF$0.65 CSCL 20D

The problem of stationary flow about an arbitrary smooth body by a supersonic stream of non-viscous non-thermoconductive gas is examined. It is assumed that the body is stationary, and the stream far in front of the body is uniform. The study is restricted to flow in the region between the bow wave and the body up to the next discontinuity. Author

N67-24473*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

FORCED-CONVECTION HEAT-TRANSFER CORRELATIONS FOR GASES FLOWING THROUGH WIRE MATRICES AT SURFACE TEMPERATURES TO 5500°R

William L. Maag and William F. Mattson Washington, NASA, May 1967 22 p refs

(NASA-TN-D-3956) CFSTI: HC$3.00/MF$0.65 CSCL 20M

Experimental forced-convection heat-transfer data are presented for hydrogen, helium, and nitrogen gases flowing through electrically heated matrices made of helical coils of tungsten wire. The following are the test conditions for these data: wire diameter, 0.030 to 0.050 inch; surface temperature, 1500° to 5500°R; outlet gas temperature, 650° to 3000°R; mass velocity, 0.34 to 7.01 pounds per second per square foot; heat flux, 0.32 to 8.43 Btu per second per square inch; pressure, 1 atmosphere; porosity, 60 to 80 percent. The data are correlated by using the wire diameter as the characteristic dimension, basing the Reynolds number on the minimum mass velocity, and evaluating the physical properties of the gases at both the film and bulk temperatures. These data and those of other investigators can be represented by the single-cylinder heat-transfer correlation based on the film temperature or by a bulk-temperature correlation presented herein. Matrix types include coils, cylinder banks, and woven wire screens having porosities greater than 60 percent. Author

N67-24583 Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Berlin (West Germany).

THEORETICAL AND EXPERIMENTAL ANALYSIS OF THE STATIC PRESSURE IN A PLANE TURBULENT JET AT LOW MACH-NUMBER [THEORETISCHE UND EXPERIMENTALLE ANALYSE DES STATISCHEN DRUCKES IM EBENEN TURBULENTEN FREISTRAHL BEI KLEINER MACHZAHL]

H. Fiedler Jan. 1967 114 p refs In GERMAN; ENGLISH summary
(DLR-FB-67-04) CFSTI: HC $3.00/MF $0.65

The question of the static pressure in a plane turbulent jet at low Mach numbers is treated. Theoretical pressure distributions were obtained with the aid of the complete Reynolds equation. For the purpose of experimental investigation, the influence of the turbulence on the static pressure reading was determined by dynamic calibration of the probe. A combination probe, consisting of Pilot tube and hot wire, was also developed for measuring the static pressure in a turbulent stream. The experimental results were in good agreement with the theory. Generally it was found that in the turbulent region of the jet the static pressure is negative with respect to the pressure of the ambient still air. Particularly in the shear layer of the mixing region there occurs a pressure minimum which is about −2% of the stagnation pressure in the jet core. In the axis of the fully developed jet the pressure minimum is about −8% of the local stagnation pressure. Author

N67-24592# Aeronautical Research Council (Gt. Brit.)
VISCOSITY EFFECTS ON THE TWO-DIMENSIONAL FLOW IN CASCADES
J. P. Gostelow, A. K. Lewkowicz, and M. R. A. Shaalan 1967 47 p refs
(ARC-CP-872) CFSTI: HC $3.00/MF $0.65

An outline of three methods selected for boundary layer calculation is given. The methods are programmed in ALGOL-code and the results obtained are graphically displayed. Both theoretical and experimental velocity distributions are used in the computation. Results obtained from a new analysis are compared with those from other methods and also with experimental measurements. Applying boundary layer theory, an attempt is made to reveal the real effect of viscosity on pressure distributions in cascades. Author

N67-24594 National Engineering Lab., Glasgow (Scotland).
ON THE LINEAR THEORY OF CASCADES OF SUPERCAVITATING HYDROFOILS
G. A. Duller (Exeter Univ.) Feb. 1966 50 p refs
(NEL-218)

A linearized theory for the supercavitating flow through a two-dimensional cascade of hydrofoils has been developed, and a basic Deuce alphacode program has been written. With small additions to this program, the cavitation number, the deflection angle, the pressure rise, and the force coefficients can be calculated for any given cascade geometry. Author

N67-24814*# National Aeronautics and Space Administration, Washington, D.C.
THE COSINE LAW IN THE KINETIC THEORY OF GASES [DAS COSINUSGESETZ IN DER KINETISCHEN GASTHEORIE]
M. Knudsen May 1967 8 p refs Transl. into ENGLISH from Ann. Physik (Leipzig), v. 48, 1915 p 1113–1121
(NASA-TT-F-486) CFSTI: HC $3.00/MF $0.65 CSCL 20D

The validity of the cosine law, developed in earlier experiments on the flow of gases through narrow pipes, is proved for the case of absence of temperature equilibrium in the flow of gases reflected from a surface cooled by liquid oxygen. The experimental method and the apparatus used are described, with equations for the number of mercury molecules reflected from a rigid wall. The validity of the cosine law was demonstrated by the finding that the mercury coating, formed on the condensing surface, was of uniform density no matter whether temperature equilibrium existed or not. Author

N67-24815*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
ANALYTICAL AND EXPERIMENTAL STUDY OF BOILER INSTABILITIES DUE TO FEED-SYSTEM–SUBCOOLED REGION COUPLING
Thomas M. Grace and Eugene A. Krejsa Washington, NASA, May 1967 28 p refs
(NASA-TN-D-3961) CFSTI: HC $3.00/MF $0.65 CSCL 20M

A study was made of instabilities occurring in a forced-flow, electrically heated, downflow boiler with constant exit pressure. Steady-state conditions and the frequency of oscillation were measured at the onset of oscillations for various feedline characteristics. A model representing the dominant dynamic characteristics of the boilers is presented. This model was verified by the use of impedance concepts, known characteristics of the feed system, and experimental data. Author

N67-24652# Lincoln Lab., Mass. Inst. of Tech., Lexington.
MONTE CARLO SIMULATION OF THE FLOW OF A RAREFIED GAS AROUND A CYLINDER
Alan W. Starr 18 Jan. 1967 63 p refs
(Contract AF 19(628)-5167); ARPA Order 600; Proj. Defender)
(TN-1967-7; ESD-TR-67-41; AD-647124) CFSTI: HC $3.00/MF $0.65

A Monte Carlo technique is described for simulating the high-speed flow of a rarefied gas around a cylindrical body. The method uses a hard-sphere model, or, alternatively, the 'Maxwellian' model to compute collisions between particles. A representative 'test particle' is scattered in such a way that its statistical behavior approximates that of a random particle chosen from the actual gas. This requires knowledge of the distribution function of 'target' particles, which is estimated from observations of the behavior of the test particle. The method is applicable to any collision model and to any model for the interaction between the gas and the surface of the body. Author (TAB)

N67-24701# Raytheon Co., Bedford, Mass. Missile Systems Div.
SOUND-RECEPTION AND FLOW-NOISE OF SIMPLE LINES AND PERFORATED PIPES IN MOTION
Ewald Eichler 31 Jan. 1967 68 p refs
(Contract N00014-66-C0013)
(BR-4073; AD-646861) CFSTI: HC $3.00/MF $0.65

Extended acoustic receivers that sample a pressure-field by means of a simple propagating wave and their realization in the form of a microphone-terminated perforated pipe are studied. Motion through the medium subjects a receiver to apparent changes of frequency, to loss of surface reactance, and to flow-noise. It is found that at subsonic velocities the receiver-gain generally decreases with increasing velocity. In the perforated pipe, the phase-speed of sound can exceed the speed of sound in the free medium; true end-fire reception, at least at one frequency, becomes possible through the Doppler-effect. The flow-noise for a number of receiver-lengths and axial velocities is calculated on the basis of several models of the homogeneous and inhomogeneous turbulent boundary-layer pressurefield. The experimental flow-noise, whether obtained in the wind-tunnel or in free-fall through the atmosphere, lies generally higher. Author (TAB)

N67-24719# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE VELOCITY OF SMALL PERTURBATIONS AND THE EXISTENCE OF WEAK SHOCK WAVES IN A RADIATING GAS TAKING INTO ACCOUNT RADIATION PRESSURE
V. A. Prokof'yev 8 Aug. 1966 29 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. I, Fiz i Khimii (Moscow), no. 1, 1960 p 43–59
(FTD-MT-65-234; AD-646380) CFSTI: HC $3.00/MF $0.65

On the basis of hydrodynamic equations of Navier-Stokes, taking into account the mechanical action of equilibrium radiation, consideration is given to propagation of plane harmonic weak perturbations (pressure waves and thermal waves) in equilibrium medium at rest, thermal and calorific state of which are given in very general form. There is obtained a formula for adiabatic speed of sound, taking into account radiation pressure, and the characteristic (frequency) equation of the Kirchhoff-Langevin type.
Author (TAB)

N67-24729# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE COMPUTATION OF FLOW AT LARGE KNUDSEN NUMBERS
M. N. Kogan and L. M. Degtyarev 14 Jul. 1966 21 p refs Transl. into ENGLISH from Astronaut. Acta (Vienna), v. ii, no. 1, 1965 p 36–42
(FTD-TT-65-1959; TT-66-10831; AD-646460) CFSTI: HC $3.00/MF $0.65

A method is presented for the numerical solution of the Boltzmann Equation which seems to have some advantages over the usual method of moments. The formative influences on molecular flow are discussed and examples of the calculation are given for flows close to free-molecular flow with the Monte-Carlo-method. The results of the calculation confirm the existence of the molecular boundary layer.
Author (TAB)

N67-24772# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE FORMULATION OF TWO DIMENSIONAL EDDY CURRENT PROBLEMS OF A COMPRESSIBLE LIQUID IN TURBOMACHINES
Ya. A. Sirotkin 14 Jul. 1966 19 p refs Transl. into ENGLISH from Inzh. Zh. (Moscow), v. 4, no. 2, 1964 p 254–262
(FTD-TT-65-1924; TT-67-60776; AD-646419) CFSTI: HC $3.00/MF $0.65

The fluid dynamic properties of the eddy current are treated mathematically.
TAB

N67-24795# Nebraska Univ., Lincoln. Dept. of Mechanical Engineering.
A THEORETICAL AND EXPERIMENTAL STUDY OF THE FLUID MOTION ABOUT A FLAT PLATE ROTATED IMPULSIVELY FROM REST TO A UNIFORM ANGULAR VELOCITY Final Report
T. Sarpkaya Dec. 1966 28 p refs
(Contract Nonr-3718(03))
(NU-HYDRO-027-TS; AD-646834) CFSTI: HC $3.00/MF $0.65

The report presents the results of an experimental and theoretical investigation of separated unsteady flow about a flat plate (a fin or aileron) rotating impulsively from rest to a uniform angular velocity about an axis along its leading edge in an incompressible fluid otherwise at rest or moving steadily and uniformly about the plate. The results show that the early stages of motion are accompanied by torsional oscillations, the frequency of which is identical with the natural frequency of the submerged system. The initial hydrodynamic torque is determined by the added mass-moment of inertia of the plate. In the oscillatory stage of motion the torque is comprised of an angular-velocity-dependent form-torque and an acceleration-dependent inertial torque. These torque components are interdependent as well as time-dependent. The rotation of the plate in a steady uniform flow gives rise to a hinge moment which is considerably larger than that of a plate held fixed at the same instantaneous angle of incidence.
Author (TAB)

N67-24803# Giannini Controls Corp., Malvern, Pa. Astromechanics Research Div.
THE EFFECTS OF VELOCITY PROFILE ON THE FLOW IN A STRAIGHT CHANNEL WITH INJECTION
W. Selden Saunders Feb. 1967 22 p refs
(Contract AF 49(638)-1459)
(AFOSR-66-0887; AD-648673) CFSTI: HC $3.00/MF $0.65

The very simple sensitive flow that occurs in a straight channel subject to a cross-flowing jet is presented. This case has been treated previously under the assumption of uniform velocity profiles. The present paper extends this treatment using the more realistic assumption of non-uniform velocity profiles. However, the complex, detailed solution of the Navier-Stokes equation is not required in order to obtain useful information regarding this case. Instead, only the basic concepts of conservation of momentum and energy are utilized, along with the definition of two form parameters describing the non-uniformity of the velocity profile. Using only these tools, an insight into the effects of the velocity profile is obtained.
Author (TAB)

N67-24809# Stanford Univ., Calif. Thermosciences Div.
AN EXPERIMENTAL STUDY OF TURBULENT BOUNDARY LAYER ON ROUGH WALLS
C. K. Liu, S. J. Klein, and J. P. Johnston Jul. 1966 188 p refs
(Contract AF 49(638)-1278; Grant NSF GP-2720)
(MD-15; AFOSR-67-0420; AD-647268) CFSTI: HC $3.00/MF $0.65

Experimental data are presented on flow structure, mean, and fluctuating velocities in turbulent boundary layers over a family of flat surfaces with transverse roughness elements made of square bars of variable spacing. All flows were incompressible and had zero streamwise pressure gradient. The flow structures are described for surfaces extending from hydraulically smooth to fully rough. A distinct flow pattern is observed in the wall region for each of four cases: smooth, skimming, wake-interference and isolated-roughness flow. Maximum roughness was observed with a ratio of gap to bar width of approximately 11. The most obvious effect of an increase in surface roughness is the distinct increase of turbulence production and the concomittant increase in the value of eddy viscosity. It is shown that this increase in eddy viscosity increases the total thickness of the layer in the same way that an increase in molecular viscosity would do in a laminar layer. The normalization of eddy viscosity for the outer portion of the layer as suggested by Clauser is found to apply to the rough surfaces studied.
Author (TAB)

N67-24860# Aerospace Research Labs., Wright-Patterson AFB, Ohio. Hypersonic Research Lab.
THE LINEARIZED RAYLEIGH PROBLEM IN A RAREFIED GAS FLOW ACCORDING TO THE BGK MODEL Final Scientific Report
Kanakanahalli S. Nagaraja Sep. 1966 103 p refs
(ARL-66-0186; AD-646558) CFSTI: HC $3.00/MF $0.65

The classical Rayleigh problem was formulated using the BGK kinetic equation, and the numerical evaluation is carried out on an IBM 7094. The results describe the macroscopic velocity q sub x, the shear stress P sub xy, the tangential heat flux Q sub x, and the temperature field T in the near-free-molecule flow. These results are obtained for a wide range of values of lambda t (the number of inter-molecular collisions in a time t). The flow picture is physically plausible, and agrees in regions of common validity with other available results. For example, the velocity-slip on the surface, which is half of the impulsive velocity, V, in the free-molecule limit, decreases with increasing collision numbers (lambda t), and finally vanishes in the Rayleigh limit (or the continuum limit). The boundary layer thickness also decreases with increasing lambda t. The initial formulation of the problem involves only the first power of q sub x which is much smaller than the local speed of sound. Using a higher approximation by retaining the (q sub x)

squared term, the temperature fields are obtained for the near-free-molecule flow. In further work it is proposed to use these results so that the compressibility effects may be included through an iteration scheme. Author (TAB)

N67-24891# California Inst. of Tech., Pasadena. Div. of Engineering and Applied Science.
NONLINEAR BUBBLE OSCILLATIONS
Louis P. Solomon and Milton S. Plesset Jan. 1967 22 p refs
(Contract N00014-67-0094-0009)
(Rept.-85-38; AD-646755) CFSTI: HC$3.00/MF$0.65

Numerical solutions were obtained for the motion of a gas bubble in an incompressible liquid when harmonic pressure oscillations are imposed. The mean pressure in the liquid was taken to be 1 atm and the ratio of oscillating pressure amplitude, A, to the mean pressure was given the values 0.2, 0.5, 1.0 and 2.0. The equilibrium bubble radius was chosen to be R sub o = .01, .001 and, .0001 cm, and the angular frequency of the pressure variations was omega = 20,000, 70,000, and 120,000 per sec. The phenomena of bubble explosion or collapse were found for large A, i.e., 1.0 and 2.0. For the smaller values of A, the bubble radius varied with time within well-defined limits, but nonlinear effects were evident. Author (TAB)

N67-24899# Naval Ordnance Lab., White Oak, Md.
EFFECTS OF FOREIGN GAS INJECTION AND LAMINAR BOUNDARY LAYER STABILITY AT LOW MACH NUMBERS
John O. Powers and Lorenzo M. Albacete 12 Sep. 1966 28 p refs
(NOLTR-66-155; RR-266; AD-646747) CFSTI: HC $3.00/MF $0.65

The stability characteristics of laminar boundary layer profiles including foreign gas injection were evaluated by solving the disturbance equations for the eigenvalues which define the minimum critical Reynolds number for neutral stability. The profiles utilized demonstrate the differences which accrue from using light and heavy molecular weight gases as the injectant. Results obtained by asymptotic procedures for Mach numbers less than 1.3 show that the heavier gas (carbon tetrachloride) resulted in markedly more stable boundary layers than a lighter gas (helium). Author (TAB)

N67-24939# Douglas Aircraft Co., Inc., Long Beach, Calif.
SOLUTION TO THE BINARY DIFFUSION LAMINAR BOUNDARY LAYER EQUATIONS INCLUDING THE EFFECT OF SECOND-ORDER TRANSVERSE CURVATURE
N. A. Jaffe, R. C. Lind, and A. M. O. Smith Arnold Eng. Develop. Center, Feb. 1967 88 p refs
(Contract AF 40(600)-1000)
(LB-32613; AEDC-TR-66-183; AD-647285) CFSTI: HC $3.00/MF $0.65

The report presents a numerical method for solving the binary diffusion laminar boundary-layer equations. The differential equations of continuity, momentum, energy, and species diffusion are solved simultaneously for two-dimensional or axisymmetric flow. For the case of axisymmetric flow the second-order transverse curvature terms appearing in the equations are retained. Relations for mixture fluid properties as functions of local conditions in the boundary layer are developed and used in obtaining solutions to the equations. The mixtures considered in the investigation are He - air, Ar - air, and CO2 - air. Solutions to the equations are given for flow of a pure air free stream over a 9 degree half angle cone at a free stream Mach number of 10 and free stream Reynolds number, based on cone slant length of 940. The initial section of the cone is solid and mass injection is initiated at a location downstream of the tip. Results are presented and compared for calculations both including and neglecting the second-order transverse curvature effect. Author (TAB)

N67-24963# Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).
LOW DENSITY HIGH TEMPERATURE GAS DYNAMICS Final Scientific Report, 1 Nov. 1965–31 Oct. 1966
J. J. Smolderen Dec. 1966 12 p refs
(Grant AF-EOAR-66-16)
(AFOSR-67-0414; AD-647391) CFSTI: HC$3.00/MF$0.65

The objective is the development of sensitive instrumentation for the study of low density hypersonic flows with particular emphasis on the transitional and near free molecule regimes. Modulated hot wire probes show a change in sensitivity of less than 10% over several days operation. Earlier results indicating large changes were shown to be spurious and were due to contamination of the wires by vacuum pump oil. A model actuator operating in the region of 15 Hz was constructed and successfully tested under vacuum conditions. The actuator is the essential component in planned experiments on first collision effects. Preliminary studies of the magnetohydrodynamic measurement of local velocity by means of the Faraday effect indicate qualitative agreement with theory. Author (TAB)

N67-24986# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.
A TABULAR PRESENTATION OF THE SURFACE BOUNDARY LAYER MODELS OF WEBB, BUSINGER, AND PANOFSKY
Frank V. Hansen Jan. 1967 151 p refs
(ECOM-5104; AD-646700) CFSTI: HC$3.00/MF$0.65

Three hypotheses for a diabatic surface boundary layer were examined (as a function of the gradient Richardson number) by numerical integration methods. The models are presented in tabular form in terms of diabatic wind influence function, the gradient stability ratio and a universal function that corrects for thermal stratification in unstable air. Author (TAB)

N67-24993# Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).
LAMINAR SEPARATION IN SUPERSONIC AND HYPERSONIC FLOWS Final Report, 1 Oct. 1965–30 Sep. 1966
Jean J. Ginoux 30 Sep. 1966 67 p refs
(Grant AF-EOAR-66-6)
(AFOSR-67-0615; AD-647819) CFSTI: HC$3.00/MF$0.65

Static pressure, recovery temperature and heat transfer distributions were measured on flat plates with flaps at a Mach number of 2.02. A uniform amount of heat was dissipated at the surface of the models. The angle of the flaps was varied between 1.5 deg. and 21 deg. Laminar, transitional, and turbulent flows were considered. Well defined plateau pressures existed when reattachment was transitional and not in fully laminar flows. A large peak of recovery temperature existed, when transition was in the reattachment zone, followed by fairly low recovery temperatures. Heat transfer distributions were measured at a Mach number of 6.7 on a cone-cavity model with air injection into the separated flow region. The mass injection rate was varied between zero and a maximum equal to the mass flow in the boundary layer at separation. The effect of injection was to considerably reduce the heat transfer rate to the cavity floor and in the reattachment region of the flow. At an injection rate of about 0.25 at separation, the heat transfer was found to be reduced below the cone values over the whole surface of the body. At higher rates of injection, transition moved forward with correspondingly larger heat rates. Author (TAB)

N67-25015*# National Aeronautics and Space Administration, Washington, D. C.
PROPAGATION OF A TURBULENT JET IMPACTING ON A FLAT SURFACE [RASPROSTRANENYE TURBULENTNOY STRUY, SOUDARYAYUSHCHEYSYA S PLOSKOY POVERKHNOST'YU]

O. V. Yakolevskiy and S. Yu. Krashennikov Mar. 1967 11 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekh. Zhidkosti Gaza (Moscow), no. 4, 1966 p 192–197
(NASA-TT-F-10784) CFSTI: HC $3.00/MF $0.65 CSCL 20D

Consideration of the flow phenomena caused by the collision of a turbulent jet with a flat surface at a certain angle of incidence. Such problems originate in static tests, in the study of the "ground effect" manifested in the appearance of velocity and temperature discontinuities at engine intake for aircraft with vertical or short takeoff, or in ventilation equipment, etc. Test results are used as the basis for derivation of formulas for approximate calculation of the flow phenomena. Author

N67-25035*# Farnham (Frank C.) Co., Philadelphia, Pa.
LINEARIZED UNSTEADY NONEQUILIBRIUM FLOWS OF COMPRESSIBLE GAS [LINEARIZOVANNYYE NEUSTANOVIVSHIYESYA NERAVNOVESNYYE TECHENIYA SZHIMAYEMOGO GAZA]
Zh. S. Sislyan Washington, NASA, Oct. 1966 15 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSR, Mekhan. Zhidkosti i Gaza (USSR), no. 2, 1966 p 37–46
(Contract NASw-1497)
(NASA-TT-F-10380) CFSTI: HC $3.00/MF $0.65 CSCL 20D

A discussion is given of the field of a disturbed flow produced by the unsteady motion of a thin foil or of the surface of an infinite circular shell situated in a uniform equilibrium gas flow. Relevant equations are derived and analyzed. Author

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N67-23539# Air Force Cambridge Research Labs., Bedford, Mass. Space Physics Lab.
GEOPHYSICS AND SPACE DATA BULLETIN, VOLUME III, NO. 2 Second Quarter, 1966
Anne L. Carrigan and Norman J. Oliver, ed. 1966 186 p refs
(AD-646084) CFSTI: HC $3.00/MF $0.65

Contents: Total field intensity magnetometer; Cosmic ray neutron intensity monitor; Oblique high-frequency propagation; Riometer; Solar optical patrol observations; Solar radio emission; Vertical incidence ionospheric soundings. TAB

N67-23593# California Univ., Livermore. Lawrence Radiation Lab.
ON THE AVAILABILITY OF PHASE SPACE DURING THE BUILDUP OF THE E-LAYER
N. C. Christofilos 20 Dec. 1966 9 p refs
(Contract W-7405-ENG-48)
(UCID-15064) CFSTI: HC $3.00/MF $0.65

Calculations for determining the buildup of the ionospheric E region are described. The numerical description begins with an equation for the total number of electrons in the E region. Under the conditions discussed there does not appear to be any limit in phase space to inhibit E-region buildup to the ffield reversal level. NSA

N67-23726# Arkansas Univ., Fayetteville. Dept. of Chemistry.
ATMOSPHERIC RADIOCHEMISTRY Annual Progress Report
31 Dec. 1966 73 p refs
(Contract AT(40-1)-2529)
(ORO-2529-6) CFSTI: HC $3.00/MF $0.65

Developments are reported on studies of: time interval between nuclear detonation and formation of single fallout particles; cosmic-ray-produced ^{28}Mg in rain; global circulation of nuclear debris from May 14, 1965, nuclear explosion; and radioactive Sr, Ce, and Mn isotopes in the atmosphere. Volatile fission products and those with gaseous or volatile precursors were found to be highly depleted in single fallout particles from the May 9, 1966, Chinese nuclear explosion. It appears that about 30 to 40 sec elapsed between the time of nuclear detonation and the beginning of formation of the particles. The existence of cosmic-ray-produced 21.3-hr ^{28}Mg in rain at concentrations of 1.7 and 6.1×10^{-1} atoms/cc was established radiochemically by isolating this nuclide from several hundred liters of rain samples collected at Fayetteville (94°W, 36°N), Arkansas. The highest concentrations of ^{90}Sr and ^{144}Ce in air, 5.37 and 122 dpm/SCF, respectively, were found in April 1963, at 64–70°N and at an altitude of 16.7 km. The highest concentration of ^{54}Mn, 11.2 dpm/SCF, was observed in April 1963, at 65°N and at an altitude of 10.6 km. The bulk of ^{54}Mn produced in the Soviet nuclear detonation in October 1961, appears to have reached the troposphere in the spring of 1963. NSA

N67-23731# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.
HIGH-ALTITUDE MEASUREMENTS ON NATURAL RADIOACTIVITY [MESURE DE LA RADIOACTIVITE NATURELLE DE L'AIR EN ALTITUDE A L'AIDE D'UN BALLON CAPTIF]
[1965] 5 p In FRENCH
(NP-16438) CFSTI: HC $3.00/MF $0.65

Sampling devices used to measure natural radioactivity up to altitudes of 1km are described. The method of attaching the devices to a balloon is described. NSA

N67-23837# Environmental Science Services Administration, Boulder, Colo. Inst. for Telecommunication Sciences and Aeronomy.
RADIO NOISE DATA Quarterly Report, Jun.–Aug. 1966
W. Q. Crichlow, R. T. Disney, and M. A. Jenkins Nov. 1966 65 p refs
(IER-18-ITSA-18-27; AD-645024) CFSTI: HC $3.00/MF $0.65

A number of radio noise recording stations are operated in a program co-ordinated by the Environmental Science Services Administration. Measurement results are given as month-hour and time block median and decile values. The parameters recorded are the noise power expressed in terms of an effective antenna noise factor, f sub a, and the mean voltage and mean logarithm expressed as deviations, V sub d and L sub d, in dB below the average power. No systematic statistical editing of the records has been attempted in this publication. The data should be used, realizing the values given may reflect levels of atmospheric noise, man-made noise, or station interference. Author (TAB)

N67-23914*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MAGNETIC DECLINATION AND SOLAR CONTROL OF THE TOPSIDE IONOSPHERE
R. J. Fitzenreiter, R. A. Goldberg, and B. V. Krishnamuthy Feb. 1967 37 p refs
(NASA-TM-X-55763; X-615-67-21) CFSTI: HC $3.00/MF $0.65 CSCL 04A

A theoretical model based on the skewness between magnetic control and geographically oriented solar control is reviewed and its predictions concerning topside vertical and latitudinal density slope behavior are compared with Alouette I Topside Sounder results on the 75th meridian from 400 to 1000 km. The measurements closely match the model, with latitudinal slopes exhibiting large magnitude changes due to declination and vertical slopes exhibiting smaller alterations in the predicted manner. The results indicate that the declination effect must be considered as an important

perturbation when analyzing data in mid dip latitude regions having declinations in excess of 5°. Solar effects were isolated in the topside equatorial regions, the general result being that at all altitudes, solar control contributes to a flattening of latitudinal slope at latitudinal positions of at least ±10° dip-latitude about the solar position. The data demonstrate the occurrence of the equatorial anomaly on the 75th west meridian at times as early as 1000 local mean time. Author

N67-23920*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
RARE-EARTH AND BARIUM ABUNDANCES IN THE BUNUNU HOWARDITE
John A. Philpotts, C. C. Schnetzler, and H. H. Thomas Oct. 1966 10 p refs
(NASA-TM-X-55753; X-641-66-432) CFSTI: HC $3.00/MF $0.65 CSCL 08D

Abundances of the rare-earth elements and barium in the Bununu howardite have been determined by mass-spectrometric stable-isotope dilution. Briefly, the analytical technique consists of dissolving the sample, adding isotopic "spikes" of the rare-earths and barium, and concentrating these elements by passing the solution through an ion-exchange column. No attempt was made to separate the rare-earths from each other or from other elements with similar partition coefficients. Isotopic analysis was done with a triple-filament, solid-source mass-spectrometer. The results of the rare-earth and barium analyses are tabulated. The data have been normalized to hypothetical chondritic abundances based on a comparison of the analyses of rare-earths in eucrites. For comparison, the data also have been normalized to the average rare-earth abundances in chondrites determined by neutron activation and the average barium abundance. The two sets of normalized data agree within 15%. Author

N67-23922# Massachusetts Inst. of Tech., Cambridge. Dept. of Meteorology.
OBSERVATIONAL STUDIES OF THE ATMOSPHERIC GENERAL CIRCULATION
Victor P. Starr and Barry Saltzman, comp. 1 Jul. 1966 705 p refs
(Contract AF 19(628)-5816)
(SR-2; AFCRL-66-589; AD-645365) CFSTI: HC $3.00/MF $0.65

Observational research results dealing with the general circulation of the atmosphere, obtained from investigations carried on at M.I.T. during the past eighteen years are summarized for more convenient reference, primarily with a view to the study of analogous behavior in certain respects of other cosmical fluid systems such as the solar atmosphere in particular. A total of seventy six selected papers are included in the volume, together with a preface and foreword by the compilers. A list of project reports issued during the period is also appended. TAB

N67-23940# Ballistic Research Labs., Aberdeen Proving Ground, Md.
REVIEW OF THE HIGH ALTITUDE RESEARCH PROGRAM (HARP)
C. H. Murphy and G. V. Bull (McGill Univ.) Jul. 1966 50 p refs
(BRL-R-1327; AD-645284) CFSTI: HC $3.00/MF $0.65

Project High Altitude Research Program (HARP) is directed toward the use of guns for scientific probing of the upper atmosphere. The attractive features of guns for this purpose are the basic economy of such a system and the high inherent accuracy of guns for placement at altitude as well as accuracy in ground impact. The basic liability for such an approach lies in the very high accelerations experienced by gun-launched payloads. The guns used in Project HARP vary in size from 5-inch and 7-inch extended guns on mobile mounts to transportable fixed 16-inch guns. Altitude performance varies from 20 pound, 5-inch projectiles reaching 240,000 feet to 185-pound, 16-inch projectiles reaching 470,000 feet. Single and multiple stage rockets launched from the 16-inch gun have very promising predicted performance and are under development. Scientific results to date are primarily wind profiles measured by radar chaff, aluminized balloons and parachutes, and tri-methyl-aluminum trails, although a number of successful 250 MHz and 1750 MHz telemetry flights were made. Sun sensors, magnetometers, and temperature sensors were flown and an electron density sensor was fired in early June. Author (TAB)

N67-23945*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
RARE-EARTH ANALYSIS BY A MASS SPECTROMETRIC STABLE ISOTOPE DILUTION TECHNIQUE
C. C. Schnetzler, H. H. Thomas, and John A. Philpotts [1967] 12 p refs
(NASA-TM-X-55765; X-641-67-166) CFSTI: HC $3.00/MF $0.65 CSCL 08D

A technique for the analysis of rare-earth element abundances in rocks and minerals by mass spectrometric stable isotope dilution has been developed. The technique is being used at present for the routine analysis of europium and the seven even-atomic-number rare-earths; this is sufficient to clearly delineate the general rare-earth abundance pattern. The method yields results that are comparable, if not superior, in quality to those of neutron activation; it is also faster and simpler. Rare-earth abundances in the rock-standards W-1 and G-1 have been determined. Author

N67-23964*# National Aeronautics and Space Administration Goddard Space Flight Center, Greenbelt, Md.
ON THE ION COMPOSITION AND TEMPERATURE IN THE TOPSIDE IONOSPHERE
H. G. Mayr, L. H. Brace, and G. S. Dunham Dec. 1966 57 p refs
(NASA-TM-X-55740; X-621-66-573) CFSTI: HC $3.00/MF $0.65 CSCL 04A

In the topside ionosphere the altitudinal distribution of protons in diffusive equilibrium deviates strongly from that in chemical equilibrium through charge-exchange with O^+. The particle continuity equations for H^+ and O^+ and the energy continuity equation are solved simultaneously by means of a computer program. The processes included are photoionization, charge-exchange, ambipolar diffusion along magnetic field lines, heat conduction, local and nonlocal heating, and heat loss from ions to neutrals. The ion composition and plasma temperature along various field lines are derived and studied by adopting electron density and temperature from Explorer XXII measurements (1000-km altitude, vernal equinox) as boundary conditions. The O^+–H^+ composition transition region at middle and low latitudes is fully described. It is found that a neutral hydrogen concentration of 2×10^5/cc at 500 km is required to make the calculated electron density consistent with satellite measurements of electron density at 650 km. Author

N67-23976*# National Aeronautics and Space Administration Goddard Space Flight Center, Greenbelt, Md.
RARE-EARTH ABUNDANCES IN AN ANORTHOSITE AND A MANGERITE
John A. Philpotts, C. C. Schnetzler, and H. H. Thomas Sep. 1966 8 p refs
(NASA-TM-X-55755; X-641-66-447) CFSTI: HC $3.00/MF $0.65 CSCL 08D

Rare earth abundances in an anorthosite sample from Tchitogama Lake, Quebec, and in a quartz-mangerite sample from Grenville Township, Quebec, were determined by mass spectrometric stable-isotope dilution analyses. Results of the analyses are tabulated. The data were normalized to hypothetical chondritic abundances based on a comparison of neutron activation analyses of rare earths in eucritic meteorites found in the literature. Plots of the chondrite normalized abundances of the rare earths in the anorthosite and the mangerite are depicted, and are discussed. L.S.

N67-23992 Kakioka Magnetic Observatory (Japan).
GEOMAGNETIC OBSERVATIONS AT KANOYA, JAPAN IN 1961
Y. Yasui and T. Yoshimatsu 1966 120 p refs *Its* No. 46

Results are presented of geomagnetic observations made at the Kanoya Magnetic Observatory in 1961. The methods and equipment used are briefly discussed. The tabulated results include hourly values of magnetic declination, horizontal intensity, and vertical intensity; mean hourly values of magnetic elements for all days, calm days, and disturbed days; mean hourly values of north and west components; three hour range indices, K and character figures, C; and the general character of principal magnetic disturbances. Also presented are reproductions of magnatograms. R.N.A.

N67-23993 Kakioka Magnetic Observatory (Japan).
GEOMAGNETIC OBSERVATIONS AT MEMAMBETSU, JAPAN IN 1961
Y. Yasui and T. Yoshimatsu 1966 120 p refs *Its* No. 44

The results of geomagnetic observations carried out at the Memambetsu Magnetic Observatory in 1961 are presented in tabular form. The methods and equipment used are briefly described. Included are tables of hourly values of magnetic inclinations, magnetic horizontal intensity, and magnetic vertical intensity; mean hourly values of magnetic elements for all days, calm days, and disturbed days; mean hourly values of north and west components; three hour range indices K and C; and the general character of principal magnetic disturbances. Reproductions of magnetograms are also presented. R.N.A.

N67-24008# Pennsylvania State Univ., University Park. Dept. of Geology and Geophysics.
STUDIES OF THE EFFECT OF DEPTH OF FOCUS ON SEISMIC PULSES Final Report, 1 Jan. 1962–31 Oct. 1966
B. F. Howell, Jr. and P. M. Lavin 31 Oct. 1966 44 p refs
(Contract AF 19(628)-238; ARPA Order 292)
(AFCRL-66-764; AD-646035) CFSTI: HC $3.00/MF $0.65

This report summarizes the conclusions reached in thirty other reports issued in connection with this contract, and lists the individual reports which detail how each of the objectives of the contract was reached. The principal method used in an attempt to measure depth-of-focus of shallow events is the Watson-Merdler inverse-filtering technique. It is shown that a simplified version of this method which neglects noise also finds ghosts in a seismogram, as does cross-correlation. The three methods frequently but not always find the same ghosts. Two important factors which make it difficult for all three methods to find ghosts are that short-period seismometers do not record the main part of the energy in most seismic pulses and the ghosts commonly differ greatly from their primaries in waveform and frequency spectrum. TAB

N67-24011# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CHARACTERISTIC OF RADIO WAVE ABSORPTION DURING VERTICAL SOUNDING OF THE IONOSPHERE OVER ASHKHABAD
M. Shirmamedov 2 Sep. 1966 20 p refs Transl. into ENGLISH from Issled. Ionosfery i Meteorov: Sb. Statei (USSR), no. 13, 1964 p 89–96
(FTD-TT-65-2040; TT-67-60504; AD-645834) CFSTI: HC $3.00/MF $0.65

Results are presented of the absorption measurements carried out in Ashkhabad during the years 1954 - 1960. Diurnal, seasonal and annual variations of absorption are considered. The annual absorption variations are compared with the solar activity (Wolf's numbers). Frequency dependence of the absorption factor is given on the basis of the data obtained at the time of solar flares. Absorption values for days of a quiet ionosphere are compared with absorption values for days of magneto-ionospheric disturbances. The problem of focusing of radiowaves from the ionosphere is considered. Appearance of reflection coefficient greater than 1 is pointed out as natural. Author (TAB)

N67-24023 Kakioka Magnetic Observatory (Japan).
GEOMAGNETIC OBSERVATIONS AT KAKIOKA, JAPAN IN 1961
Y. Yasui and T. Yoshimatsu 1967 125 p
(Rept.-41)

Details are given on the instrumentation and building plans of the observatory as well as the results of geomagnetic observations. In the area of magnetic observations, consideration is given to absolute observations, variometers, scale values, base-line values, hourly values and associated mean values, geomagnetic indices K and C, the general character of principal magnetic disturbances, and the reproduction of magnetograms. Extensive tables are presented giving such data as hourly values of magnetic declination; hourly values of horizontal and vertical intensity; mean hourly values of magnetic elements for all days, calm days, and disturbed days; and mean hourly values of north and west components. Reproductions of magnetograms are also included. L.E.W.

N67-24024 Kakioka Magnetic Observatory (Japan).
GEOMAGNETIC OBSERVATIONS AT KAKIOKA, JAPAN IN 1962
Y. Yasui and T. Yoshimatsu 1967 116 p For Abstract see N67-24023
(Rept.-42)

N67-24049# Joint Publications Research Service, Washington, D. C.
TRANSLATIONS ON COMMUNIST CHINA SCIENCE AND TECHNOLOGY, NO. 370: HYDROLOGICAL FACTORS IN THE FORMATION OF UNDERGROUND WATER IN PIEDMONT-PLAIN ARID AREAS
Hsi-p'eng Fan 2 Mar. 1967 20 p refs Transl. into ENGLISH from Ti-Chih Hsueh-pao (Peking), Mar. 1962 p 15–24
(JPRS-40094; TT-67-30741) CFSTI: $3.00

A discussion is given of the hydrothermal distribution characteristics of the intermontane basins and the surrounding mountain areas in accounting for the regional division of the underground water. The role rivers play in feeding the underground water supplies is examined, and the method and subsequent effect of runoff are discussed. C.T.C.

N67-24306# California Univ., Los Angeles.
INVERSION METHODS
Zdenek Sekera *In* Natl. Center for Atmospheric Res. Satellite Data in Meteorol. Res. Dec. 1966 p 299–310 refs (See N67-24283 12-20)

Discussed are inversion methods used to determine the aerosol and dust content of the molecular atmosphere, and methods used in the ultraviolet and visible regions. Extensions of prescribed methods to studies of skylight polarization, turbidity effects, and ground reflection are cited. S.C.W.

N67-24307# National Center for Atmospheric Res., Boulder, Colo.
DETERMINATION OF OZONE PARAMETERS FROM MEASUREMENTS OF THE BACK-SCATTERED RADIATION
Jitendra V. Dave and C. L. Mateer (Meteorol. Serv. of Canada) *In its* Satellite Data in Meteorol. Res. Dec. 1966 p 311–322 refs (See N67-24283 12-20)

An approximate method of obtaining values of total ozone in the solar atmospheric column from satellite measurements of ultraviolet radiation backscattered by the atmosphere is described. It is shown that meaningful information on total atmospheric ozone may be obtained by considering the effects of multiple scattering

and that extensive theoretical-numerical study is necessary if the satellite is to be kept active over the greatest fraction of its orbit for obtaining reliable total ozone information. S.C.W.

N67-24371# Geotechnical Corp., Garland, Tex.
STUDY OF SHORT-PERIOD NOISE Semiannual Report, 30 Jun.–30 Dec. 1966
Eduard J. Douze 24 Feb. 1967 57 p
(Contract AF 49(638)-1150)
(TR67-9; SAR-9; AD-647820) CFSTI: HC $3.00/MF $0.65

The data recorded at the four-seismograph array at Station Inge Lehmann, Greenland, shows that the noise is incoherent between seismographs at periods less than 1.5 sec. For periods greater than 1.5 sec, coherences are high. The velocities of the waves on the noise have not been determined. The detection capability of the site is discussed. A 17-element array is recommended if the array is to be expanded. Author (TAB)

N67-24481# GCA Technology Div., GCA Corp., Bedford, Mass.
GEOPOTENTIAL—GEOMETRIC ALTITUDE RELATIONS
R. A. Minzer Oct. 1966 18 p refs
(Contract AF 19(628)-6085)
(GCA-TR-66-12-A; AFCRL-66-787; SR-2; AD-647771) CFSTI: HC $3.00/MF $0.65

The influence of the acceleration of gravity on atmospheric properties varies with latitude and with altitude as the acceleration of gravity similarly varies with these parameters. One method for normalizing the variation of atmospheric properties with respect to the variation of the acceleration of gravity is to express the values of the atmospheric properties as a function of geopotential. The relationships between geopotential and geometric altitude are then used to apply the atmospheric data to the proper altitudes at any particular latitude. Tables of such relationships for altitudes from 0 to 1000 km for latitudes from 0 to 90 degrees are presented. Author (TAB)

N67-24483# GCA Technology Div., GCA Corp., Bedford, Mass.
GEOPOTENTIAL VERSUS GEOMETRIC ALTITUDE FROM 0 TO 10,000 KILOMETERS FOR VARIOUS LATITUDES
R. A. Minzer Oct. 1966 89 p refs
(Contract AF 19(628)-6085)
(GCA-TR-66-10-A; AFCRL-66-786; SR-1; AD-647770) CFSTI: HC $3.00/MF $0.65

Simple analytical relationships between geopotential H-psi and geometric altitude Z-psi for various latitudes psi are presented with the required constants for relating H-psi to Z, and Z-psi to H at each of eight latitudes 0, 15, 30, 45, 60, 75, 90 deg., and at the reference latitude R equal to 45 deg. 32 ft. 33 in. which latitude corresponds to the standard sea-level gravity, 9.80665 m/sq.sec. Values of HR(Z) were computed for geometric altitudes between 0 and 10,000 km; values of ZR(H) were computed for the equivalent range of geopotentials, between 0 and 3900 standard geopotential kilometers (km). Computed values of Z-psi and H-psi for the other latitudes are presented as differences (Z-psi - ZR) and (H-psi - HR) as functions of both argument pairs HR(Z) and ZR(H) are compared with the corresponding values from the U.S. Standard Atmosphere HS(Z) and ZS(H). These comparisons show the difference (HS - HR) to be -33 meters at ZR = 700 km, while the difference (ZS - ZR) is shown to be 55 meters at the corresponding value of HR = 630 km. Author (TAB)

N67-24634* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MAGNETIC FIELD MEASUREMENTS WITH THE IMP II SATELLITE
D. H. Fairfield and Norman F. Ness Nov. 1966 64 p refs
(NASA-TM-X-55632; X-612-66-530) CSCL 04A

Two onboard monoaxial fluxgate magnetometers measured magnetic fields in interplanetary space, the magnetosheath, and the magnetosphere. Analysis of over 325 hours of interplanetary data revealed structuring of the interplanetary magnetic field into four recurring sectors of approximately equal size. Average fields within each sector were directed either toward or away from the sun near the theoretical spiral angle. Field directions in the magnetosheath were found to be highly dependent on the sector direction. Results suggest that fields convected through the bow shock front undergo compression and an angle change at the shock and subsequently tend to become aligned tangent to the magnetopause. Comparisons with onboard plasma detectors showed very good agreement in identifying the magnetosheath. Results demonstrate solar wind distortion of the magnetosphere and the gradual formation of the magnetic tail in the dawn-to-midnight region. Author

N67-24703# Stanford Research Inst., Menlo Park, Calif.
STUDIES OF THE CHEMISTRY OF UNPOLLUTED ATMOSPHERES Final Report
Christian E. Junge 10 Nov. 1966 114 p refs
(Contract Cwb-11151)
(AD-646465) CFSTI: HC $3.00/MF $0.65

Measurements of aerosol concentration and size distribution were made with a light scattering type particle counter and condensation nuclei counters at sea level and 2200 meter altitudes using sites at Cape Blanco, and Crater Lake, Oregon. The data collected in marine air masses support earlier findings of sea-spray aerosol size distributions and lack of chemical fractionation during bubble burst aerosol formation. The data indicate that significant amounts of sea spray aerosol do not penetrate to low and mid-tropospheric altitudes above 2000 meters. The aerosols typical of this elevation were found to have size distributions well approximated by a power law with an exponent of 3 to 4. They were found to have sulfur to chloride ratios of about 8 and considerable concentrations of substances other than sulfur and chloride. High altitude tropospheric air mass aerosols, observed on this program at Crater Lake during periods of subsidence, have lower concentrations than found for lower altitude tropospheric aerosols and their power law representations are characterized by lower exponential values. Author (TAB)

N67-24705# Mitre Corp., Bedford, Mass.
CLOUD DROPLET MICROWAVE DISPERSION EFFECTS ON LINE INTEGRAL REFRACTOMETER MEASUREMENTS
L. J. Galbiati Bedford, Mass., AFSC, Electron. Systems Div., Oct. 1966 107 p refs
(Contract AF 19(628)-5165)
(MTR-53; ESD-TR-66-78; AD-646718) CFSTI: HC $3.00/MF $0.65

The magnitude and characteristic of the effect of cloud-droplet microwave dispersion on line integral refractometer (LIR) measurements was determined for environmental conditions measured at the Eastern Test Range on August 7, 8, and 9, 1963. It was definitely determined that the presence of cloud droplets would introduce errors in the LIR measurements, but that, on each of the above days, there were regions of the sky where the error introduced was small compared to the total refraction correction. The report describes technical areas where basic data were inadequate and discusses the impact of assumptions made in these areas on the calculated values. Author (TAB)

N67-24710# Air Force Cambridge Research Labs., Bedford, Mass.
VLF SFERICS OF VERY LARGE VIRTUAL SOURCE STRENGTH
Charles B. Kalakowsky and Edward A. Lewis Sep. 1966 29 p refs *Its* Phys. Sci. Res. Papers No. 261
(AFCRL-66-629; AD-646974) CFSTI: HC $3.00/MF $0.65

Two stations in New England, spaced 68.6 miles apart, recorded sferic waveforms in the frequency band 2.4 to 310 kHz.

Individual sferic sources whose virtual locations, as determined by triangulation with crossed-loop direction finders, fell within two areas of 290 square miles each were identified, and those producing peak fields equivalent to 20 V/m at 50 miles at both stations were selected. In over two years of recording there were only 27 such sources, the largest giving 58 V/m at both stations. Waveforms from the same source had nearly the same shape at the two stations, but occasional amplitude disparities as great as 2:1 were noted. It is shown that such cases are consistent with an idealized model in which the source is an elevated, time-varying dipole moment with its axis inclined away from the vertical. On the ground plane, the electric field pattern is then directive and the magnetic field lines are circles about a virtual source displaced horizontally from the actual source. Crossed-loop direction finders would thus indicate the direction of the virtual source, rather than the true source. All 27 sferics had rise times in the 4 to 20 microsec range, but differed in initial polarity, duration, and number of oscillations. Those recorded on the same day from virtual sources in the same area tended to have the same polarity, but over the entire recording period the polarities were nearly equally divided between positive and negative. These sferics appeared as single events, rather than multiple events, and occurred predominantly in the daytime from April through October, usually in conjunction with cold fronts and squall lines in or near the monitored areas. Author (TAB)

N67-24751# Advanced Metals Research Corp., Burlington, Mass.
RESEARCH DIRECTED TOWARD THE ELECTRON MICROANALYSIS OF MINERAL PHASES IN CHONDRITE METEORITES Final Report, Sep. 1964–Sep. 1966
Donald M. Koffman and Robert E. Ogilvie 30 Sep. 1966 54 p refs
(Contract AF 19(628)4366)
(AFCRL-66-730; AD-647126) CFSTI: HC $3.00/MF $0.65

Chemically analyzed standards of olivine, orthopyroxene and clinopyroxene were examined in the AN electron beam microanalyzer to obtain calibration information for the conversion of X-ray intensity to composition. This calibration information was employed to determine the olivine and orthopyroxene (low calcium) compositions of thirty one unequilibrated ordinary chondrites. The chemistry of the olivine, orthopyroxene and clinopyroxene minerals in fourteen equilibrated chondrites of the H, L, and LL groups were determined, and the variation of chemistry within each group was found to be quite small. Author (TAB)

N67-24761# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
MEASUREMENT OF THE TOTAL IONIZATION INTENSITY NEAR THE GROUND AND SEPARATION OF THE VARIOUS COMPONENTS [MESURE DE L'INTENSITE TOTALE D'IONISATION AU VOISINAGE DU SOL ET SEPARATION DE SES DIFFERENTES COMPOSANTES]
Philippe Grevet (Ph.D. Thesis) 1966 55 p refs In FRENCH
(CEA-R-2880; PB-169899) CFSTI: HC $3.00/MF $0.65

In a study of ionization, measurements were made of the intensity of gamma rays, beta rays, and alpha rays. Consideration was also given to separation of alpha ionization, gas, and aerosols. It was shown experimentally that the gamma component varies according to the nature of the ground, that the alpha component may be affected by a factor of 15 under specified meteorological conditions, and that the beta component varies on a much weaker scale. Transl. by R.Ll.

N67-24767# Lowell Technological Inst. Research Foundation, Mass.
INVESTIGATION OF THE TURBULENT STRUCTURE AND DRIFT MOTIONS IN THE IONOSPHERE Final Report, 1 Apr. 1962–30 Jan. 1966
James E. Gorman, Klaus Bibl, Kirtland H. Olson, and Bodo W. Reinisch Dec. 1966 78 p refs
(Contract AF 19(628)-412)
(LTIRF-254/IP; AFCRL-66-577; AD-645030) CFSTI: HC $3.00/MF $0.65

A system that measures amplitude and phase within a high-frequency pulse of 2.35 MHz is described. Using a manually controlled precise gate, phase and amplitude information of each pulse are recorded on analog tape and later digitized for computer analysis. By connecting three antennas alternately to the receiver, the system is used for ionospheric drift measurements. Phase coherence of the receiver intermediate frequency with the pulse repetition rate permits an actual phase division in comparing the 60 kHz IF phase with a 15 kHz reference which follows the phase of one antenna. Thus the phase information becomes usable for drift analysis. Additionally, continuous records of phase path and absorption integral are available on charts for further studies of the E- and D-region. Continuous records of group and phase heights, as well as ionograms, permits classification of the type of the reflection layer. As shown, the fading pattern used for drift analysis originates mainly at the reflecting layer. This fact allows use of the reflection type for classification of the drift results. Author (TAB)

N67-24785# Space-General Corp., El Monte, Calif.
PASSIVE MICROWAVE MEASUREMENTS OF SNOW AND SOIL. VOLUME II: ANALYSIS Technical Report, 2 Sep. 1965–31 May 1966
J. M. Kennedy, A. T. Edgerton, R. T. Sakamoto, and R. M. Mandl 5 Nov. 1966 106 p refs
(Contract Nonr-4767(00))
(SGC-829R-4, Vol. II; TR-2; AD-647257) CFSTI: HC $3.00/MF $0.65

The program for the passive microwave radiometric measurements of snow was expanded to include beach sands, marine swamp, and playa lake beds. Data obtained on in situ materials further confirmed that moisture content is an important parameter, probably the most important one, affecting radiometric brightness temperatures. The effect of water seems to be independent of the base material, so that increasing the free water content has a similar effect whether the base material is snow, soil or sand. The brightness temperature varies with changing water content in slightly different degrees for different materials, but the effect is similar. The theoretical prediction that the melt condition of new snow, as well as old snow, can be measured using microwave radiometers has been further confirmed. Also, it seems highly probably that both density and snow thickness may be determined by careful analysis of microwave data. TAB

N67-24793# Space General Corp., El Monte, Calif.
PASSIVE MICROWAVE MEASUREMENTS OF SNOW AND SOIL. VOLUME I: INSTRUMENTATION AND MEASUREMENTS Technical Report, 2 Sep. 1965–31 May 1966
J. M. Kennedy, A. T. Edgerton, R. T. Sakamoto, and R. M. Mandl 5 Nov. 1966 244 p refs
(Contract Nonr-4767(00))
(SGC-829R-4, Vol. I; TR-2; AD-647256) CFSTI: HC $3.00/MF $0.65

The basic objectives of the program are to measure the radiometric brightness temperatures of snow, sand, soil, mud and rock, both in the field and in the laboratory, and to relate these measurements to physical parameters, changes in environment and sensor frequencies. The major effort was devoted to field measurements of in situ, undisturbed material. The general principles of microwave radiometry are discussed in some detail in AD-627 667. That report also describes the equipment used. Some modifications of that equipment have been incorporated into the total system, and have increased the efficiency of operations and data acquisition. TAB

N67-24820# Computer Sciences Corp., El Segundo, Calif.
A DESCRIPTION OF THE NAVAL WEAPONS LABORATORY SATELLITE GEODESY SYSTEMS
R. S. Galka Dahlgren, Va., Naval Weapons Lab., Jan. 1967 124 p refs
(Contract N178-8965)
(NWL-TM-K-6/67; AD-646731) CFSTI: HC $3.00/MF $0.65

Artificial near-earth satellites are prolific sources of geodetic information-data about the size and shape of the earth and its gravitation field. The Naval Weapons Laboratory, through the Satellite Geophysics Program, has been involved in satellite orbit determination and geodesy since 1960. This report provides an over-view description of the NWL Satellite Geophysics Program, its functions, operations, and computer programs. Pertinent billets for the Astronautics Division (KA) of the Computation and Analysis Laboratory (K-Lab) are described. Author (TAB)

N67-24821# Columbia Univ., Palisades, N.Y. Lamont Geological Observatory.
MEASUREMENT OF P AND S SOUND VELOCITIES UNDER PRESSURE OF LABORATORY MODELS OF THE EARTH'S MANTLE Annual Summary Report, 15 Dec. 1965–14 Dec. 1966
Edward Schreiber 14 Dec. 1966 42 p refs
(Contract AF 49(638)-1355; ARPA Order 292-66)
(AD-646782) CFSTI: HC $3.00/MF $0.65

The results of velocity measurements performed on specimens of polycrystalline forsterite with 6% porosity, a single crystal spinel, and on obsidian are reported. The velocities of compressional and shear waves were determined at both ambient (25C and 1 bar) conditions and as a function of pressure on all three specimens. Velocity as a function of temperature was measured to 150C at 1 atm on the obsidian specimen. TAB

N67-24857# Denver Univ., Colo.
STUDY OF SUB-AUDIO GEOMAGNETIC FLUCTUATIONS Final Scientific Report, 1 Oct. 1961–31 Dec. 1966
George L. Mason and Charles R. Higgins 28 Feb. 1967 78 p refs
(Contract AF 19(628)-204)
(DRI-2368; AFCRL-67-0063; AD-647845) CFSTI: HC $3.00/MF $0.65

Recording of natural fluctuations of the geomagnetic field, in the frequency range .01 to 5 cps at Barrow, Alaska and Huancayo, Peru, and in the 1 to 50 cps range at Shickley, Nebraska and Huancayo, Peru, is described. The schedule of recording periods actually realized between 1 October 1961 and 31 December 1966 is given. The recording system used for the .01 to 5 cps range is described, together with auxiliary instrumentation developed in connection with recording operations in this range, and for playback and reduction of both frequency ranges. Examples of reduced data in the form of Octave-Band and 1/6 Octave-Band plots are presented for the 1 to 50 cps range, also Rayspan spectral analysis charts. Schumann resonance phenomena are clearly displayed in both forms of presentation. Author (TAB)

N67-24866# Pennsylvania State Univ., University Park. Ionosphere Research Lab.
A SUBSONIC D-REGION PROBE EXPERIMENT USING AN ULTRAVIOLET SOURCE TO PRODUCE IONS AND FREE ELECTRONS
Edward L. Gee 20 Dec. 1966 55 p refs
(Contract AF 19(628)-4014)
(AFCRL-67-0050; SR-286; AD-647890) CFSTI: HC $3.00/MF $0.65

An ultraviolet source for use in a Lower D-region probe experiment has been constructed. The use of this source with an ion collector probe designed by Hale and Hoult is described. It is felt that a lower limit on the order of 107 NO molecules per cm3 could be detected with this experiment. Author (TAB)

N67-24885# Denver Univ., Colo. Dept. of Physics.
ATMOSPHERIC ABSORPTIONS OVER LONG SLANT PATHS IN THE STRATOSPHERE
David G. Murcray, Frank H. Murcray, and Walter J. Williams Oct. 1966 59 p refs
(Contract AF 19(628)-5202; ARPA Order 363)
(AFCRL-66-812; SR-4; AD-645542) CFSTI: HC $3.00/MF $0.65

The variation of the infrared solar spectrum with altitude was observed during a series of balloon flights made from Fairbanks, Alaska. Spectra were obtained at various altitudes with solar zenith angles ranging from 49 degrees to 92 degrees. These spectra were used to determine the atmospheric transmittance to be expected at high altitudes and particularly over very long slant paths in the stratosphere. The transmittance data are presented in this report. The spectral region scanned during this flight covered the 2.7 mu region. The major atmospheric absorptions in this region are due to carbon dioxide and water vapor. The paths traversed by the solar radiation in reaching the spectrometer when the solar zenith angle is greater than 90 degrees are such that a major portion of the air mass traversed by the radiation is traversed in a relatively narrow altitude interval close to the minimum height of the ray. Thus these long paths provide a method of sampling the absorption to be expected in relatively narrow layers. The water vapor absorptions obtained under these conditions have been used to determine the amount of water vapor present in these layers in the stratosphere. These data are compared with the mixing ratios determined on the basis of the change in these absorptions during a flight with small solar zenith angle. The agreement is within the accuracy of the measurement and shows no indication that the data of the normal flight are inaccurate due to contamination. The profile indicates the increased mixing ratio above the tropopause noted on other flights at other geographic locations. TAB

N67-24889# Aeronautical Chart and Information Center, St. Louis, Mo.
COMPLEX INTERPRETATION OF GEOPHYSICAL OBSERVATION DATA IN THE SEA OF OKHOTSK AND THE KURIL-KAMCHATKA ZONE OF THE PACIFIC OCEAN [KOMPLEKSNAYA INTERPRETATSIYA MATERIALOV GEOFIZICHESKIKH NABLYUDENIY V OKHOSKOM MORE I KURILO-KAMCHATSKOY ZONE TIKHOGO OKEANA]
A. G. Gainanov, Yu. V. Tulina, I. P. Kosminskaya, S. M. Sverev, and P. Veitsman Jan. 1967 11 p Transl. into ENGLISH of "Resul'taty Issledovaniy po Mezhdunarodnym Geofizicheskim Proyektam-Seismicheskiye Issledovaniya" Moscow, Nauka, no. 6, 1965 p 60–65
(ACIC-TC-1158; AD-645020) CFSTI: HC $3.00/MF $0.65

A comparison of the results of aeromagnetic and gravimetric surveys and of the deep seismic sounding data enables us to make certain conclusions about the nature of magnetic and gravity anomalies in the region under study. The sources of magnetic anomalies in different structures of the Sea of Okhotsk are confined to the upper part of the granitic layer and to the bottom portions of this layer or the upper part of the basaltic layer. In the Pacific ocean, off the shores of the Kuril Islands, the anomalies are related to the very upper part of the Earth's crust section; east of the abyssal trench axis, - to the basaltic layer and probably to the upper portions of the subcrustal layer. A comparison of the gravitational field and the Earth's crust sections obtained by deep seismic sounding makes it possible to point out regions of an anomalous density of the subcrustal matter. Author (TAB)

N67-24897# National Bureau of Standards, Boulder, Colo. Inst. for Environmental Research.
A REVIEW OF THE RESEARCH ON GEOMAGNETIC PULSATIONS IN JAPAN

Takao Saito (Tokyo Univ.) Dec. 1966 67 p refs
(IER-15; ITSA-15; AD-647764)

The paper summarizes research on geomagnetic micropulsations in Japan with emphasis upon the studies since 1957. The pulsations are classified by period and form into the five groups: pc 1, pc 2, 3, pc 4, pc 5, and pi 1, 2. Morphological and theoretical studies of each are summarized separately. Author (TAB)

N67-24902# Marine Engineering Lab., Annapolis, Md.
A COMPILATION OF SELECTED DATA ON SOLAR RADIATION AT SEA LEVEL
B. H. Morgan Feb. 1967 21 p refs *Its* Assignment-91-195
(MEL-3/67; AD-646355) CFSTI: HC$3.00/MF$0.65

A spectral distribution curve of solar irradiance at sea level, over the range of 0.3 to 15.0 microns, is presented. This curve was developed from data compiled by Moon in 1940, high altitude solar irradiance measurements reported by Johnson in 1954, and atmosphere transmission measurements reported by Gebbie, et al, in 1951. Author (TAB)

N67-24953# Schjeldahl (G. T.) Co., Northfield, Minn.
REPORT ON SKYHOOK 1966 Final Report
C. P. Merrell and R. A. Schafer Feb. 1967 29 p
(Contract Nonr-4859(00))
(AD-647271) CFSTI: HC$3.00/MF$0.65

A series of high altitude Skyhook balloon flights were made from Flin Flon Municipal Airport of Bakers Narrows, Manitoba, and from Fort Churchill, Manitoba to secure data for Dr. Kinsey A. Anderson of the Space Sciences Laboratory, Department of Physics, University of California, for his studies of radiation associated with solar magnetic storms. The planning and execution of the 30 balloon flights is described. Time-Altitude curves and balloon trajectories are included. Author (TAB)

N67-24956# Wolf Research and Development Corp., Boston, Mass.
RESULTS OF VARYING INVESTIGATIONS INTO APPROACHES TO GEODETIC PARAMETER ESTIMATION Final Report, 1 Apr. 1965–31 Nov. 1966
Harry R. Kahler, Jerry E. Trotter, Harry L. Turner, William T. Wells, and Michael S. Willoughby Nov. 1966 189 p refs
(Contract AF 19(628)-5141)
(AFCRL-66-766; AD-647184) CFSTI: HC$3.00/MF$0.65

Presented are the results of varying investigations into approaches to geodetic parameter estimation and documentation of associated computer programs developed under the effort. Results of an investigation to utilize integrated range rate data in an unconstrained solution for station position, integration constant and bias estimates are presented. The approach appears to be feasible, however large amounts of data will most likely be required in order to overcome the effects of serial correlation introduced by the integration. It would be of maximum use in instances where there are large uncertainties in the force model or where no model can be utilized. Author (TAB)

N67-24971# American Meteorological Society, Boston, Mass.
SOME PROPERTIES OF ATTENUATION IN THE ATMOSPHERE [O NEKOTORYKH OSOBENNOSTIAKH OSLABLENIIA SVETA V ATMOSFERE]
V. E. Zuev and M. V. Kabanov Bedford, Mass., AFCRL Nov. 1966 9 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Fiz. (Tomsk), no. 6, 1965 p 175–177
(Contract AF 19(628)-3880)
(T-R-627; AD-646679) CFSTI: HC$3.00/MF$0.65

The article reports some results of experimental investigations of attenuation carried out under average turbidity conditions for three portions of the spectrum (0.43, 0.68, and 1.03mu) and for three horizontal thicknesses of the atmospheric surface boundary layer (1.21, 3.65, and 9.86 km). The immediate object of the measurement series was to obtain experimental data on the amount of diffuse radiation in 3.65 km thicknesses of the real atmosphere for small angular apertures of the receiver, and to compare these data with the theoretical data obtained earlier. The results of the experiments show that the role of diffused light under typical average turbidity conditions in the atmospheric surface boundary layer (visibility 10 to 15 km) is not constant. TAB

N67-25038* Holman (John F.) and Co., Inc., Washington, D. C.
SOME DATA ON THE MICROCHEMICAL INVESTIGATIONS OF TROILITE AND PYRRHOTITE FROM METEORITES [NEKOTORYYE DANNYYE MIKROKHIMICHESKOGO ISSLEDOVANIYA TROILITA I PIRROTINA V METEORITAKH]
S. I. Smyshlyayev Washington, NASA, Apr. 1967 8 p refs Transl. into ENGLISH from Meteoritika (Moscow), v. 27, 1966 p 53–57
(Contract NASw-1495)
(NASA-TT-F-10893) CSCL 08D

Microchemical analysis has been used to establish the chemical composition of troilite from one iron and two stonay meteorites and of pyrrhotite from two stoney meteorites. It has been established that meteoric pyrrhotite unlike terrestrial pyrrhotite contains chromium as an impurity. The presence of chromium as an impurity in troilite has been confirmed. A method for the microchemical analysis of iron sulfides in meteorites has been developed. Author

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N67-23504 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CALCULATION AND EXPERIMENTAL CHARACTERISTICS OF AN INSTRUMENT FOR THE MEASUREMENT OF A STABLE NUCLEAR REACTOR PERIOD
P. I. Popov *In its* Certain Questions in Exptl. Phys. 26 Jul. 1966 p 25–36 refs (See N67-23501 12-23)

The instrument is built on the basis of a logarithmic method of measurement. Experimental static and dynamic characteristics of the instrument are presented. Since a magnetic oscillograph with small load resistance is used for the measurement of a period, considerable attention is allotted to the calculation of the output stage of the electron amplifier. Dynamic characteristics are illustrated by oscillograms, obtained for different values of established periods. Author

N67-23505 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
OPERATION OF GAS-DISCHARGE COUNTERS WITH LARGE OVERVOLTAGE PULSES
B. A. Dolgoshein, B. I. Luchkov, and V. I. Ushakov *In its* Certain Questions in Exptl. Phys. 26 Jul. 1966 p 37–45 refs (See N67-23501 12-23)

The peculiarities of operation of standard counters MS-9, GS-9, GS-30 under conditions of controlled pulse input were investigated. Dependence of the time during which counter remembers ionization on various input pulse conditions was studied. A simple method of measurement of the propagation rate of discharge along counter filament is described. Author

N67-23514 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
BALANCING DEVICE OF AN ELECTRONIC PARAMAGNETIC RESONANCE RADIOSPECTROSCOPE
V. V. Vakhnina and V. F. Semenov *In its* Certain Questions in Exptl. Phys. 26 Jul. 1966 p 145–154 refs (See N67-23501 12-23)

The construction of a balancing device for a paramagnetic resonance radiospectroscope is described. The device, which consists of a rectangular input resonator and a coaxial receiving resonator, is shown schematically. In order to establish a theoretical basis for the construction of a balancing device with paramagnetic resonance coupling and for a system of detection, consideration is given to the process of energy transfer from source to detector, detection, and influence of residual inequilibrium of the indicated processes and to noises of high frequency power sources and thermal noises. It is pointed out that the system has an improved balance and has small losses of energy in the walls. L.E.W.

N67-23567# General Electric Co., San Jose, Calif. Advanced Products Operations.
AN OUT-OF-PILE EVALUATION OF W–Re THERMOCOUPLE SYSTEMS FOR USE TO 4700°F IN PuO_2–UO_2
P. E. Novak and R. R. Asamoto Jun. 1966 60 p refs
(Contract AT(04-3)-540)
(GEAP-5166) CFSTI: HC $3.00/MF $0.65

An out-of-pile investigation was made to determine the characteristics of W3Re/W25Re and W5Re/W26Re thermocouple systems, for use in measuring fuel temperatures under SEFOR conditions. Bare-wire tungsten–rhenium thermocouples were calibrated to temperatures above 5400°F (3000°C) in vacuum. Drift tests for 15 hours at 4700°F (2600°C) indicated good stability. The performance of thoria-insulated thermocouples was observed to be adequate and reproducible for temperature measurements to 5100°F (2800°C). Beryllia-insulated thermocouples performed satisfactorily up to 4600°F (2550°C) for short periods of time. Tungsten-26% rhenium thermocouple sheathing and mixed oxide fuel (17% PuO_2–83% UO_2) were compatible at average SEFOR fuel temperatures, but showed signs of reaction at 4700°F (2600°C). Author (NSA)

N67-23605# North American Aviation, Inc., Columbus, Ohio.
DEVELOPMENT AND EVALUATION OF A CATALOG TECHNIQUE FOR MEASURING IMAGE QUALITY
Robert W. Brainard, Robert Sadacca (Army Personnel Res. Office), Louis J. Lopez, and George N. Ornstein Washington, Army Personnel Res. Office, Aug. 1966 126 p refs Prepared jointly with Army Personnel Res. Office *Its* Tech. Res. Rept.-1150
(Contract DA-49-092-ARO-19)
(AD-645644) CFSTI: HC $3.00/MF $0.65

The technique developed for experimental evaluation was an image catalog containing a standard set of 231 images having diverse scene content and quality. The image variants in the catalog were assigned indexes of image interpretability based on the measured performance of 154 interpreters. The catalog technique requires the interpreter to compare any new image with images in the catalog and to select the catalog image most similar in quality to the new image. The indexes associated with the selected catalog image are taken as measures of the interpretability of the new image. The catalog technique had a high degree of validity, particularly when estimates were provided by trained interpreters (average correlation coefficient for target area discrimination was .77, for target identification, .54). The technique was also effective with untrained subjects, although not as high (.70 and .51). The other techniques were also effective. The technique combining catalog judgments with weighted physical measures of image quality was best for target area discrimination (.86 vs .62 for target identification); the technique using physical measures alone was best for target identification (average validity coefficient of .60 vs .43 for target area discrimination). Author (TAB)

N67-23636# ARO, Inc., Arnold Air Force Station, Tenn.
IN-CHAMBER VACUUM GAGE CALIBRATION METHOD AND ITS APPLICATION TO CRYOPUMPING MEASUREMENTS Technical Report, Jan. 1–Aug. 30, 1965
R. M. Freeman Jan. 1967 27 p refs
(Contract AF 40(600)-1200)
(AEDC-TR-66-234; AD-645509) CFSTI: HC $3.00/MF $0.65

The report describes a method of calibrating mass spectrometers and ion gages for pumping speed measurements. Sensitivity factors and pumping speed constants are determined from an analysis of the chamber pressures during gage calibration and pumping speed measurements. The CO2 sensitivity factor for the ion gage or mass spectrometer is obtained. The pumping speed constants were determined from the gage readings versus gas throughput. The method was applied to both ion gage and mass spectrometer measurements in determining the pumping speed of a 77K surface for 300K CO2, and approximately the same value of pumping speed was obtained for both gages. Author (TAB)

N67-23657*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE INSTRUMENTS
In its Supporting Res. and Advanced Develop. 28 Feb. 1967 p 239–276 refs (See N67-23641 12-11)

An infrared multidetector spectrometer for making absolute radiometric measurements is described, as is the development of a flight model infrared interferometer. The electronics for an engineering model of a multidetecting infrared radiometer is studied, and the design of a stable pulse amplification system for use with sodium iodide and cesium iodide scintillation detectors is investigated. Preliminary results for the development of a sterilizable and riggedized vidicon are included, and the slow scan testing of these vidicons is reported. The vidicon that exhibited the poorest resolution at slow scan also had the poorest image storage and the least residual signal, indicating a difference in the photoconductor structure that has apparently affected the lateral leakage characteristic of the modified antimony-sulfide-oxy-sulfide photoconductor. M.W.R.

N67-23690# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
A UNIVERSAL DEVICE FOR RECORDING OF EXPERIMENTAL RESULTS IN NUCLEAR PHYSICS MEASUREMENTS [UNIVERSAL'NYI PRIBOR ISPOL'ZUEMYI V YADERNOI FIZIKE DLYA REGISTRATSII IZMERITEL'NYKH DANNYKH]
V. Stefan'ski and S. Pakhala Jul. 1966 34 p In RUSSIAN
(INR-735/VI/E) CFSTI: HC $3.00/MF $0.65

The construction of a universal apparatus for registering the data from multichannel systems applied in nuclear physics is described. The work parameters obtained by means of this apparatus are also discussed. This system was applied in particular to registering the experimental data from a 34-channel time analyzer and a 450-channel hodoscope. Author (NSA)

N67-23691# Academia R. P. R., Bucharest. Institutul de Fizica Atomica.
MULTIMODULATED CYCLOTRON MASS SPECTROMETER WITH ALTERNATING PULSES
D. Ioanoviciu and V. Mercea 1966 19 p refs
(IFA-IS-38) CFSTI: HC $3.00/MF $0.65

The analytical calculus of the resolving power of a multimodulated cyclotron mass spectrometer (synchronometer) with alternating pulses is investigated. NSA

N67-23692# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
MIXED He-3 He-4 CALORIMETER. VERY LOW TEMPERATURE CALORIMETRY [CALORIMETRE MIXTE A HELIUM-3 ET HELIUM-4. CALORIMETRIE A TRES BASSE TEMPERATURE]
Olivier Testard (Ph.D. Thesis—Paris Univ.) 1966 113 p refs In FRENCH
(CEA-R-3073) CFSTI: HC$3.00/MF$0.65

A description is given of a double-jacket calorimeter using helium-4 and helium-3 as the cryogenic fluids and making it possible to vary the temperature continuously from 0.35 to 4.2°K. By using an electric thermal regulator together with liquid hydrogen it is possible to extend this range up to about 30°K. A review is made of the various methods available for measuring specific heats. The method actually used in the apparatus previously described is described in detail. The difficulties arising from the use of an exchange gas for the thermal contact were solved by the use of adsorption pumps. Author (NSA)

N67-23700# Iowa State Univ. of Science and Technology, Ames.
NUCLEAR SPECTROSCOPIC STUDIES WITH A SEMICONDUCTOR DETECTOR COINCIDENCE SYSTEM
Thaddeus Joseph Englert, F. Everling, G. W. Eakins, and E. N. Hatch Nov. 1966 89 p refs
(Contract W-7405-ENG-82)
(IS-1478) CFSTI: HC$3.00/MF$0.65

A coincidence spectrometer has been constructed which utilizes the properties of semiconductor detectors and sodium–iodide scintillation detectors. Measurements of relative intensities of conversion electrons from ^{207}Pb and ^{175}Lu were determined using this system and the values found are in good agreement with measurements made with magnetic spectrometers. To demonstrate further its versatility, the coincidence system was used to study the Compton effect using the 570-and 1064-keV gamma rays from ^{207}Pb. The problem of obtaining a pure electron spectrum with semiconductor detectors when the electrons are being emitted in the presence of a photon spectrum was studied and two methods of suppression of the photon background were investigated. Electron–electron coincidence measurements using semiconductor detectors and electron gamma coincidence measurements using a sodium–iodide scintillation counter in conjunction with a semiconductor detector were made to study the decay scheme of ^{175}Lu following the electron capture decay of ^{175}Hf. Author (NSA)

N67-23757# United Nuclear Corp., Elmsford, N. Y.
CARBON METER FOR SODIUM Progress Report, 21 Feb.–30 Jun. 1966
31 Jul. 1966 40 p refs
(Contract AT(30-1)-3665)
(UNC-5160) CFSTI: HC$3.00/MF$0.65

Development of a probe for continuous measurement of C activity in Na is described. The probe is to be a thin-walled tube, probably Fe or Ni, immersed in the Na and carrying a controlled flow of decarburizing gas. The C flux diffusing through the tube wall, as measured by a gas analyzer, is intended to serve as a measure of the C activity in the Na. A program plan for development of a complete instrument ready for field tests in less than two years is described. A preliminary design study is reported. A test rig for measuring C flux as a function of the major variables is nearing completion. Author (NSA)

N67-23788*# National Aeronautics and Space Administration, Washington, D. C.
USING PHASE TRANSITIONS TO IMPROVE THERMOSTATIC CONTROL OF INSTRUMENTS
K. Ye Veselov, L. V. Kalisheva, and M. L. Telepin May 1967 13 p refs Transl. into ENGLISH from Prikl. Geofiz. (Moscow), n. 45, 1965 p 145–156
(NASA-TT-F-467) CFSTI: HC$3.00/MF$0.65 CSCL 14B

Existing methods for the thermostatic control of gravity meters and their shortcomings are discussed and, the use of phase transformation for the accurate control of temperature is proposed. Experimental investigations carried out for the purpose of developing phase transformation thermostats since 1954 are discussed. Experience in the use of ice, gallium and its eutectic alloys, and saturated hydrocarbons in phase transformation thermostats is reviewed. Author

N67-23819*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
EXPERIMENTAL STUDY OF THE APPLICATION OF PENETROMETER TECHNIQUE TO THE LUNAR SURVEYING STAFF CONCEPT
Huey D. Carden Washington, NASA, May 1967 38 p refs
(NASA-TN-D-3937) CFSTI: HC$3.00/MF$0.65 CSCL 14B

Mockups of the lunar staff were constructed, and impact tests were conducted on target materials having a wide range of hardness or penetrability to evaluate conceptual and alternative penetrometer designs. Acceleration time histories generated during the impact of penetrometers integral with the staff revealed distinguishing characteristics on penetrable target materials including sands and balsa; however, on firm targets such as lead and concrete, the impact acceleration signatures were distorted by superimposed high-frequency structural responses of the staff. An alternate configuration in which the penetrometer was link-mounted to the side of the staff appeared to eliminate the deficiencies of the integral design. Characteristics of the impact acceleration time histories are shown to provide convenient means for distinguishing between the bearing strength of granular target materials. An increase in target bearing strength is accompanied by an increase in the impact peak acceleration and a decrease in both the total duration of the acceleration pulse and the staff penetration depth. Author

N67-23829# Naval Research Lab., Washington, D.C.
AIRBORNE SENSORS
O. D. Sledge 16 Sep. 1966 29 p refs
(NRL-Memo-1717; AD-640027) CFSTI: HC$3.00/MF$0.65

Formulas are developed for the response of an airborne radiometer to the microwave radiation from the atmosphere and the terrain. Corresponding formulas are derived for the response of an airborne radar antenna to the radar return from the earth in the narrow frequency range of operation of the radiometer. Both diffuse and specular areas of the terrain are considered in the theoretical treatments. When operating over the same isothermal diffuse surface of the earth, the theory shows that the deviation of the power output of the radiometer antenna from its time average value is linearly proportional to the negative of the deviation of the radar antenna output from its mean value, provided the relative gain of the radiometer antenna is the square of the relative gain of the radar antenna. Using the developed formulas, the power response of the microwave radiometer and radar are calculated for a simple earth model. The results of the calculations show that the two sensors, using antennas of identical radiation properties, have complementary characteristics. Author (TAB)

N67-23830# Ballistic Research Labs., Aberdeen Proving Ground, Md.
AN EIGHT-CHANNEL HIGH-PERFORMANCE OSCILLOGRAPH RECORDING SYSTEM
Bernard Soroka and George T. Watson May 1966 63 p refs
(BRL-MR-1765; AD-640863) CFSTI: HC$3.00/MF$0.65

A high-performance, eight-channel, electro-optical recording system for recording pressure-time histories of blast phenomena is

described. The system has a frequency response of 0.03 cycles per second to 250 kilocycles per second with an input impedance of 1600 megohms. These are fully adequate characteristics for accurate piezoelectric gage recording. The system can also be used as an eight-channel, single-sweep recording system using Polaroid cameras. The system is characterized by high accuracy, reliability and stability, and provides for ease of operation and maintenance. TAB

N67-23840# Naval Ship Engineering Center, Philadelphia, Pa.
INSTRUMENT STANDARDS
E. L. Lewis, ed. 1 Jul. 1966 346 p 13 ed.
(AD-644371) CFSTI: HC$3.00/MF$0.65

The Standard Plans contained in this binder constitute Applied Physics Department Instrument Practice as of the Date of Issue. They are subject to revision without notice to holders of this binder. They represent only repetitive items; each test measurement system is designed according to its own requirements, the standards being used where applicable. Beginning with the 11th Edition, the Standards specifically concerned with Flow Measurement have been removed from this volume and are being issued as a separate publication. The assembly of these standards into a separate volume has been done to facilitate their use by those whose primary area of interest is in the field of fluid flow measurement and calculation. Author (TAB)

N67-23874# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
OPTICS OF PHOTOGRAPHIC AND AEROPHOTOGRAMMETRIC INSTRUMENTS
L. S. Urmakher 29 Jul. 1966 32 p refs Transl. into English of the Publ. "Optika Fotograficheskikhi Aerofotogrammetricheskikh Priboroo" Moscow, Nedraizd., 1965 p 170–195
(FTD-HT-66-334; TT-67-60305; AD-644065)

Contents: Objectives for ground photography; Objectives for aerial photography; Objectives for reproduction; Optical systems of instruments for photomacrography and photomicrography. TAB

N67-23875# Army Electronics Labs., Fort Monmouth, N.J.
A PROPOSAL FOR A SECONDARY STANDARD ILLUMINATION METER
R. M. Marchgraber and R. W. Armstrong Aug. 1966 22 p refs
(ECOM-2750; AD-640578) CFSTI: HC$3.00/MF$0.65

The design criteria for a filter combination that allows the conversion of a previously developed high precision caloric radiometer into a secondary illumination instrument are stated, and a technique for computing suitable filter combinations and their errors is discussed. It is shown that a combination of two Schott filters (GG 10 and KG3) yields a technologically feasible solution which deviates only about one percent from the response of the normal human eye for air masses 1 through 5. Author (TAB)

N67-23906# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ACADEMY OF SCIENCES OF THE USSR. INSTITUTE OF INFORMATION TRANSMISSION. PROBLEMS OF INFORMATION TRANSMISSION
18 Aug. 1966 30 p refs Transl. into ENGLISH from Problemy Peredachi Inform. (Moscow), no. 17, 1964 p 35–47, 112–114
(FTD-TT-65-2042; AD-643977) CFSTI: HC$3.00/MF$0.65

CONTENTS:

1. TRANSFORMATION OF LOGICAL SYSTEMS OF ALGORITHMS V. F. D'yachenko p 1–19 refs (See N67-23907 12-19)

2. OPTIMUM METHODS OF PHOTOGRAPHING FAINT OBJECTS M. A. Ayngorn p 20–24 refs (See N67-23908 12-14)

N67-23908# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
OPTIMUM METHODS OF PHOTOGRAPHING FAINT OBJECTS
M. A. Ayngorn *In its* Acad. of Sci. of the USSR. Inst. of Inform. Transmission. Probl. of Inform. Transmission 18 Aug. 1966 p 20–24 refs (See N67-23906 12-14)

One of the basic factors determining the quality of a photograph of a weak object is the granularity of the image or the signal to noise ratio. Two particular problems in determining optimum conditions of photographing weak objects are considered. In the first problem, a single negative is used and the exposure at which the signal to noise ratio is maximum is determined. In the second problem, the optimum number of negatives into which the exposure should be broken up to produce a maximum signal to noise ratio on the total image is found. A previously developed model of a photographic system is used in solving these two problems. It is shown that optimum methods of photographing weak objects can have practical value in astronomy when weak stars are photographed on the relatively strong sky background and in spectrography for observing weak spectral lines. The exact superimposition of negatives does not pose special difficulties and can be accomplished by reference to the images of bright stars or bright spectral lines. R.N.A.

N67-23916# Joint Publications Research Service, Washington, D. C.
HIGH-FREQUENCY MAGNETIC RECORDING
14 Feb. 1967 18 p refs Transl. into ENGLISH from Russian Presented at the Symp. of the 2d Conf. on Magnetic Recording, Budapest, 1966
(JPRS-39892; TT-67-30540) CFSTI: HC$3.00/MF$0.65

CONTENTS:

1. POSITION AND FORM OF THE CRITICAL ZONE AND DIRECTION OF MAGNETIZATION IN HIGH-FREQUENCY MAGNETIC RECORDING V. G. Korol'kov and I. I. Mednikova p 1–6 refs (See N67-23917 12-14)

2. THE EFFECT OF TEMPERATURE ON MAGNETIC AND WORKING PROPERTIES OF MAGNETIC TAPES V. Z. Samosskiy p 7–13 (See N67-23918 12-14)

N67-23917# Joint Publications Research Service, Washington, D. C.
POSITION AND FORM OF THE CRITICAL ZONE AND DIRECTION OF MAGNETIZATION IN HIGH-FREQUENCY MAGNETIC RECORDING
V. G. Korol'kov and I. I. Mednikova *In its* High-Freq. Magnetic Recording 14 Feb. 1967 p 1–6 refs (See N67-23916 12-14)

Some of the problems associated with the critical zone near the recording head in the high frequency magnetic tape recording process are examined. The discussion covers the depth of penetration of the critical zone into the working layer of the magnetic tape, the form of the critical zone, and the direction of magnetization acquired by the tape in the critical zone. R.N.A.

N67-23918# Joint Publications Research Service, Washington, D. C.
THE EFFECT OF TEMPERATURE ON MAGNETIC AND WORKING PROPERTIES OF MAGNETIC TAPES
V. Z. Samosskiy *In its* High-Freq. Magnetic Recording 14 Feb. 1967 p 7–13 (See N67-23916 12-14)

Results are presented of experimental research concerning temperature effects on the magnetic and physical properties of

magnetic tapes along with a theoretical substantiation of the results. The principal cause of the change in physical properties of tapes upon a change of temperature is the change in magnetic properties of the powder. The magnetic properties of tapes made of cobalt ferrite powder were most affected by temperature. The change in magnetic properties of the powders is due to the temperature dependence of their magnetic anisotropy constants. R.N.A.

N67-23944*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SPACE ADAPTED STEP-SERVO ASSEMBLY ENVIRONMENTAL TESTS
Frank Liberatore, Jack Brotzman, and Raymond Wilkinson (Naval Research Lab.) Sep. 1966 11 p refs
(NASA-TM-X-55754; X-400-66-440) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The step-servo assembly is part of the OSO-D X-ray and Lyman–Alpha experiments; its function is to position a disc in one of several preselected positions, thereby controlling the amount of radiation reaching the detectors. An environmental test was conducted to determine the life expectancy in space. Test arrangements and procedures are described. The servo assembly was under continuous vacuum for 12 weeks before it failed. During this time it was operated for a total of 531 hours. Approximately 60,000 commands were received by the assembly before it failed. It is concluded that the assembly should operate satisfactorily for the expected six-month duration of the experiments. K.W.

N67-24012# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DYNAMOMETER FOR MEASURING HYDRODYNAMIC FORCES
K. F. Artomonov, B. L. Vysochanskiy, and E. V. Kostyuchenko 2 Sep. 1966 5 p Transl. into ENGLISH from Russian Patent No. 165919 (Appl. no. 834639/26-10, 6 May 1963) 2 p
(FTD-HT-66-83; AD-645828) CFSTI: HC $3.00/MF $0.65

The object of the invention is a dynamometer for measuring the hydrodynamic forces (lift and ram pressure) acting on a body with a fluid flowing around it, containing a trough with a support block on which inductive transducers of lift and ram pressure are mounted with their armatures connected with springs and a measuring device that is connected with ac bridges through switches. In order to determine the components of the forces of the hydrodynamic effect of a flow of fluids on bodies submerged in them, the elastic elements in the form of leaf springs are connected with the studied object (the body) through rods for the component of lift and ram pressure set at an angle of 90 degrees to each other. Author (TAB)

N67-24021 Royal Greenwich Observatory, Herstmonceux (England).
THE CASSEGRAIN SPECTROGRAPH OF THE YAPP 36-INCH REFLECTOR AT HERSTMONCEUX
J. D. Pope, D. R. Palmer, and J. B. Alexander London, HMSO, 1966 13 p ref *Its* Bull. 118
HMSO: 2s 6d

The optical and mechanical design is described of a grating spectograph giving dispersions of 40A/mm or 80A/mm, constructed for use with the 36-inch reflector at the Royal Greenwich Observatory. The performance of the instrument is assessed: its stability is such as to suggest that high-dispersion radial-velocity work might be done at the Cassegrain focus. Author

N67-24041# Idealab, Inc., Franklin, Mass.
MOBIUS BAND INTERFEROMETER Final Report, 20 May 1965–19 May 1966
A. H. Bullard 15 Aug. 1966 41 p ref
(Contract AF 19(628)-5184)
(AFCRL-66-647; AD-645058) CFSTI: HC $3.00/MF $0.65

In this report the procedure, techniques, and precautions observed in the design and construction of the Mobius Band Interferometer structure are discussed. Next, a review of the system design covering the servo configuration and the electronic sweep circuit is presented. The final section of the report covers in detail the operating controls and the procedure for component selection for variation of the sweep time and forward to flyback ratio. The auxiliary output features provided in the Idealab Interferometer Control Unit are described. A complete set of blue prints is provided at the end of the report. Author (TAB)

N67-24050# Wilcox Electric Co., Inc., Kansas City, Mo.
DESIGN AND DEVELOPMENT OF ILS MONITOR ADAPTER TYPE 5479X/6 Final Report
Silas W. Kelly Nov. 1966 16 p
(Contract FA-WA-4453)
(SRDS-RD-66-93; AD-646147) CFSTI: HC $3.00/MF $0.65

The object of the project was to build eight 5479X Monitors and four 5479X/1 Power Supplies as previously designed. Sixteen dual adapter units were to be developed and produced to permit the 5479X Monitor to be used in a near field monitoring system with the TRF Type field detectors now in use. The adapter was designed with maximum reliability and simplicity to operate in either localizer or glide slope function without degradation of the system. The two separate sections were designed so that for some future application they may be mounted in the 5479X Monitor with a minimum of modification to the monitor. The ILS Monitor Adapter is thus a simple unit that will permit the complex dual conversion detectors to be replaced by a simple TRF type for near field monitoring purposes. The Adapter has been thoroughly tested and evaluated with the 5479X Monitor as a system. Author (TAB)

N67-24159# California Univ., Livermore. Lawrence Radiation Lab.
SOME NEW THERMOPILE-TYPE RADIOMETRIC CALORIMETERS
Stuart R. Gunn 12 Oct. 1966 22 p refs
(Contract W-7405-ENG-48)
(UCRL-50145) CFSTI: HC $3.00/MF $0.65

Three radiometric calorimeters of varying sizes and sensitivities are described. All are of the twin steady-state heat-flow type, employing multi-junction thermopiles as the sensing elements. Two of these were extensively tested and compared with two older resistance-bridge calorimeters by use of two ^{238}Pu capsules, which were also accurately measured at another laboratory. Author (NSA)

N67-24254# Oak Ridge National Lab., Tenn.
BAUSCH AND LOMB RESEARCH METALLOGRAPH MODIFICATIONS
R. S. Crouse *In* Rocky Flats Div., Dow Chemical Co. Advan. in Metallog. 20 Oct. 1966 p 97–105 Sponsored by AEC (See N67-24241 12-17)

Modifications made to improve the utility of the optical metallographic apparatus are described, and the reasons for their development are given. These include changes in the projection screens, filter holders, Polaroid adapter, rotatable back, the adapter for the 5×7 plate holder, rotatable half-wave plate, low power objective lenses, and exposure control. M.G.J.

N67-24276# IIT Research Inst., Chicago, Ill.
REMOTE SENSING WITH OPTICAL CROSS-CORRELATION METHODS

F. R. Krause (Aero-Astrodyn. Lab.) and M. J. Fisher *In* NASA: Marshall Space Flight Center Proc. of the Interdisciplinary Symp. on Apollo Appl. Programs, 12–13 Jan. 1966 Dec. 1966 p 191–214 refs (See N67-24268 12-30)

Described is a new concept which utilizes the cross correlation of two narrow light beams for remote sensing. The method is superior over other optical methods such as schlieren, shadowgraph systems, or spectrometers, in that information for a particular spot along the line of sight can be obtained by adjusting a second beam to intersect the first at the point of interest. The integration along the two beams is then eliminated by a cross correlation of the detected fluctuations. Discussed is the means by which this new concept of combining standard spectroscopy with a statistical cross correlation analysis might be used for dynamic and kinematic studies such as the formation and motion of water vapor or dust clouds, the dynamics and production of the ozone layers, and the generation and motion of radiation belts. The concept was successfully demonstrated in measurements of turbulent fluctuations in subsonic jets. Main problems in its applicability to the Apollo Applications Program are formulated in terms of questions, such that the background information becomes apparent which is needed to establish the feasibility of particular experiments. Author

N67-24480* Lockheed Missiles and Space Co., Huntsville, Ala. Research and Engineering Center.

RAWINSONDE COMPARISON PROJECT Final Report, Sep. 1966

Don K. Weidner and John Chambers 31 Mar. 1967 248 p refs

(Contract NAS8-20082)

(NASA-CR-61168) CSCL 14B

The final results are presented of an extensive study concerning the measuring capabilities of the FPS-16 radar, GMD-2 rawin system, and transponder radiosonde instrument. The study, known as the Rawinsonde Comparison Project, is based upon 16 test observations that were taken at Point Mugu, California, Wallops Island, Virginia, and Eglin AFB, Florida. The computational procedure used in the reduction of the comparative data is discussed in detail and outlined in Appendix A. The computer output of Test No. 3, which is given in Appendix B, illustrates the contents and arrangements of all of the outputs. The many graphic plots and constant pressure and altitude tables present a summary of the comparative data of each of the 16 test observations. Theoretical accuracies that are established for the various measured and computed quantities are compared to the operational accuracies derived from an analysis of the comparative data. Author

N67-24490# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

AERIAL PHOTOGRAPHY USING WIDE-ANGLE OBJECTIVES WITH SHADED FILTERS

M. N. Tsyganov 12 Dec. 1966 11 p refs Transl. into ENGLISH from Geodez. i Kartograf. (Moscow), no. 2, 1965 p 33–37

(FTD-HT-66-392; TT-67-61123; AD-647715) CFSTI: HC $3.00/MF $0.65

The article gives a description of illumination equalizers prepared by the use of thin semitransparent metal films on filter lenses placed in a vacuum. Before 1941 these neutral filters were directly applied to the objective lenses, but it was discovered that this can be harmful to the optical properties of the latter. Nickel finds general use because of its excellent mechanical resistance to wear and the firmness of the metal-glass bond. Although the uniformity of the light distribution over the focal plane of wide angle lenses is vastly improved, the negative must still be subjected to a contrast developer. A typical formulation is given. Author (TAB)

N67-24564# Union Carbide Nuclear Co., Oak Ridge, Tenn.

A SENSITIVE PNEUMATIC BRIDGE POWDER ANALYZER

C. W. Weber and P. R. Kuehn 11 Jan. 1967 27 p refs

(Contract W-7405-ENG-26)

(K-1684) CFSTI: HC $3.00/MF $0.65

A rugged, but sensitive, instrument for the rapid determination of true density of a powder was developed, based on the pneumatic measurement of the true volume of a weighed sample. Transfer of air from a high-pressure chamber to the sample chamber gave an equilibrium pressure that was an indirect measure of the sample volume. A differential pressure transmitter measured the equilibrium pressure relative to that in a parallel, reference transfer system. The bridge design increased analytical sensitivity, minimized temperature effects, and compensated for fluctuations in initial pressures. Analytical sensitivity was readily varied for different sample types. Composition of binary powder mixtures were directly determined within three minutes. The instrument provided volume measurements with a standard deviation of ±0.015 cc, yielding true density measurements of handbook quality. Author (NSA)

N67-24584 Gt. Brit. Ministry of Supply, London.

THE DECIMETER WAVE METHOD OF MEASUREMENT INDEPENDENT OF THE DETECTOR CHARACTERISTIC FOR DETERMINING THE COMPLEX DIELECTRIC CONSTANTS OF WATER AND AQUEOUS SOLUTIONS UP TO A LOSS FACTOR OF TAN=0.87. PART 2. EXPERIMENTAL [EINE VON DER DETEKTORCHARAKTERISTIK UNABHAEANGIGE DEZIMETERWELLEN-MESS METHODE ZUT BESTIMMUNG DER KOMPLEXEN DIELEKTRIZITAETSKONSTANTEN VON WASSER UND WASSRIGE LOESUNGEN BIS ZUM VERLUSTFAKTOR TAN =0.87. TEIL 2. EXPERIMENTELLE DURCHFUEHRUNG]

H. J. Hoffmann Nov. 1966 16 p refs Transl. into ENGLISH from Z. Physik Chem. (Frankfurt), v. 225, j. 5/6, 1964 p 372–388

(TIL/T.5695) CFSTI: HC $3.00/MF $0.65

Practical construction of the measuring equipment and procedure for carrying out measurements are described. A precision short-circuiting slider for a parallel strip conductor, with effective plane of short-circuiting about 0.01mm behind its front face, is described. The accuracy of measurement is 0.6% for ϵ' and 2% for ϵ''. Author

N67-24585 European Atomic Energy Community, Petten (Netherlands). Joint Nuclear Research Center.

EMF DEVIATION OF CHROMEL/ALUMEL THERMOCOUPLES CAUSED BY NEUTRON IRRADIATION (IRRADIATION EXPERIMENT TIC-01)

R. Gottschlich and M. Bellezza Brussels, EURATOM, Dec. 1966 31 p refs

(EUR-3257.e) CFSTI: $3.00

The experiment was carried out in order to test the nuclear stability of Chromel/Alumel thermocouples, i.e. to study the emf deviation caused by neutron irradiation. A further purpose of the experiment was to get experience in handling and remote welding of radioactive wires. The capsule containing bare wires for 20 thermocouples was irradiated for two reactor-cycles, corresponding to average neutron fluxes of 4.5×10^{20} cm^{-2} thermal and 1.4×10^{20} cm^{-2} fast. After a long period of cooling, the capsule was dismantled in a cell of the hot laboratory and the calibration performed inside another hot cell. Two calibration methods were applied: Calibration of remote welded thermocouples, each of them consisting of one irradiated and one non-irradiated wire of the same composition and (2) emf comparison of thermocouple pairs welded from irradiated wires, with non-irradiated thermocouples made from wires of the same origin. The results showed a negative emf drift of irradiated thermocouples of 0.8% (average value). Author

N67-24588 Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany).
EXPERIMENTS WITH PROBES FOR MEASURING THE HOT GAS FLOW DIRECTION AND DESCRIPTION OF A PROBE ADJUSTING DEVICE [VERSUCHE AN RICHTUNGSSONDEN FUR HEISSE GASSTROMUNGEN UND BESCHREIBUNG EINES SONDENVERSTELLGERATES]
F. V. Burger-Scheidlin, B. Fuhrken, and E. Genning Sep. 1966 60 p refs In GERMAN; ENGLISH summary
(DLR-Mitt.-66-21) CFSTI: HC $3.00/MF $0.65

Water cooled probes for measuring the hot gas flow direction are investigated and the advantages of sphere or halfsphere form are demonstrated for this type of tube. The influence of diverse parameters of the streaming gas on the sensibility of these sensors is shown and data are given for the thermal resistivity. The construction of a probe adjusting device and the arrangement of automatic motion are described. Author

N67-24593 Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany).
WATER-COOLED THERMO-SENSITIVE PROBES FOR HOT GAS TEMPERATURE MEASUREMENTS [GEKUHLTE THERMOFUHLER FUR HEIZGAS-TEMPERATURMESSUNGEN]
K.-D. Emmenthal Oct. 1966 22 p refs In GERMAN; ENGLISH summary
(DLR-FB-66-70) CFSTI: HC $3.00/MF $0.65

A watercooled thermo-sensitive probe which was tested by means of an afterburning device is discussed. The length of the cooled tip exposed to the hot gas flow and coolant flow were varied. Plotting the temperature of the cooled tip against that of a normal thermocouple junction using the heatexposed length of the tip as a parameter leads to a group of substantially straight parallel lines. Influences of low-ranged variations of coolant flow on the temperature of the tip were measured if possible. Author

N67-24632* Spacelabs., Inc., Van Nuys, Calif.
PROPELLANT LEAKAGE DETECTION SYSTEM Quarterly Progress Report, 1 Dec. 1966–28 Feb. 1967
28 Feb. 1967 21 p
(Contract NAS9-6648)
(NASA-CR-65613; QPR-1) CSCL 14B

The major effort has been directed toward the detection of leakage flow rates. Graphs of the significant fluid properties for the various dimensionless parameters used in heat transfer as a function of temperature have been developed. The information contained in the working graphs has been plotted independent of system characteristic dimensions so that variations in configuration can be readily evaluated. In addition, the data will permit selection of fluids that will simulate the oxidizer and the fuel, and help in evaluating the temperature compensation required. A preliminary investigation for suitable probe and housing materials has been completed. Author

N67-24641*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
RESEARCH ACHIEVEMENTS REVIEW, VOLUME II
1966 56 p refs
(NASA-TM-X-53557) CFSTI: HC $3.00/MF $0.65 CSCL 22M

CONTENTS:

1. INTRODUCTION TO RESEARCH ACHIEVEMENTS REVIEW ON THERMOPHYSICS RESEARCH AT MSFC G. B. Heller p 1–3 refs (See N67-24642 12-33)

2. EXPERIMENTAL RESULTS IN THERMAL SIMILITUDE B. P. Jones p 5–10 refs (See N67-24643 12-33)

3. EMISSIVITY PHYSICS E. R. Miller p 11–17 refs (See N67-24644 12-33)

4. ULTRAVIOLET INTERACTIONS WITH SOLID MATERIALS G. M. Arnett p 19–26 refs (See N67-24645 12-33)

5. PEGASUS THERMAL EXPERIMENTAL RESULTS W. C. Snoddy p 27–31 (See N67-24646 12-33)

6. RESEARCH IN INSTRUMENTATION FOR RADIOMETRY AND SPECTROMETRY H. D. Burke p 33–40 (See N67-24647 12-33)

N67-24673# California Univ., Berkeley. Lawrence Radiation Lab.
A LIQUID HYDROGEN FOCUSING CHERENKOV COUNTER
R. W. Kenney, David O. Caldwell, E. E. McLaughlin, W. L. Pope, R. V. Schafer et al Sep. 1966 6 p Presented at the Intern. Conf. on Instrumentation for High Energy Physics, Stanford, Calif.
(Contract W-7405-ENG-48)
(UCRL-17129; CONF-660918-16)

A liquid hydrogen focusing Cherenkov counter is described which was used in a study of CPT invariance by measuring the intensities of surviving pions in a parallel and monoenergetic beam in order to determine the ratio of total proper lifetimes of π^+ and π^- mesons. NSA

N67-24735# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DEVICE FOR LOW-FREQUENCY PHOTOGRAPHY
M. S. Shakirzyanov 5 Dec. 1966 7 p Transl. into ENGLISH from Russian Patent no. 160846 (Appl. No. 829583/26-10, 8 Apr. 1963) 2 p
(FTD-HT-66-660; AD-646378) CFSTI: HC $3.00/MF $0.65

A device for low-frequency photography on film moving at a constant speed is designed in the form of an attachment to the photographic apparatus. It has a distinguishing feature for improving the quality of the chronophotograms obtained. The attachment has a system of two or more shutters with the slowest shutter providing the necessary photographing frequency, and the fastest shutter providing the shortest exposure time. Another device has a feature for turning the head of the photographic apparatus and the shutter system in that the head is connected by a flexible shaft to the multishutter attachment axle on which a system of gear transmissions providing different shutter speeds is mounted. Author (TAB)

N67-24739# Naval Training Device Center, Orlando, Fla.
PHYSICAL AND OPTICAL PROPERTIES OF PROJECTION SCREENS Final Report, Jan.–Mar. 1966
Robert J. Klaiber Dec. 1966 57 p refs
(NAVTRADEVCEN-IH-63; AD-647132) CFSTI: HC $3.00/MF $0.65

The scattered, inconsistent and incomplete data in the literature have prompted a comprehensive study of the physical and optical properties of projection screens. A large sample number of front and rear projection screens was obtained, representing the industry line of January 1965. The reflected and transmitted flux distribution of each sample was measured using a small, collimated test beam of white light incident normally and at 45 degrees. A vacuum photodetector, spectrally matched to the eye, was situated on a radius arm and capable of viewing the test sample at any angle in a plane. The reflectance or transmittance of the samples was calculated using data from the measured reflected flux distribution of an easily reproduced magnesium oxide standard. Measurements were made of resolving power and physical properties, and the maximum angular viewing field of each screen was determined for a typical projection geometry and tolerable field brightness gradient. Author (TAB)

N67-24826# Army Engineer Research and Development Labs., Fort Belvoir, Va.
MICROWAVE RADIOMETRIC STUDIES IN RELATION TO MINE DETECTION

Charles N. Johnson and Dwight L. Gravitte Nov. 1966 89 p refs
(Rept.-1875; AD-646730) CFSTI: HC$3.00/MF$0.65

Field investigations over clay-type soils of the Fort Belvoir area indicated that microwave radiometry is highly unsuitable for mine detection for the following reasons: (1) Numerous strong and highly variable radiation signals from soils almost completely mask mine detection signals even under the most favorable summer conditions. (During moist soil and thermally neutral conditions which prevail during much of the spring, fall, and winter, detection performance can be expected to deteriorate even more.) (2) Microwave radiation originates in upper 2 in. to 4 in. of soil of moderate moisture content (13 to 20 percent) because of soil attentuation. When soil moisture approaches saturation conditions (30 to 40 percent), emitted radiation is confined to surface. (3) Strong similarity exists between thermal responses of microwave radiometer and typical infrared detector to mine signals. Infrared detector offers greater potential promise because of image-forming capability obtainable with high inherent resolution of infrared compared to microwave frequencies. Author (TAB)

N67-24827# Naval Medical Research Inst., Bethesda, Md.
A TEN-EVENT TONE-CONTROL SYSTEM FOR A PROGRAMMING OF EXPERIMENTS
Seward Smith and Peter M. Edmondo Dec. 1966 13 p
(Rept.-22; AD-646638) CFSTI: HC$3.00/MF$0.65

A tone control system for use in programming complex experiments is detailed. It utilizes coded tone-pulses recorded on a standard dual-track audio tape recorder. The system provides ten different coded pulses which are detected by a sound operated relay and a pulse steering network. The pulse steering network used to select which of the ten output pulses will appear at any instant is described in detail. A circuit diagram using standard Grason-Stadler relay components is given as is a circuit utilizing standard electronic components. Author (TAB)

N67-24853# Edgerton, Germeshausen and Grier, Inc., Bedford, Mass.
EXPOSURE PREDICTIONS FOR GEODETIC SATELLITE PHOTOGRAPHY BY STELLAR PHOTOMETRY
P. T. Gates 30 Nov. 1966 42 p refs
(Contract AF 19(628)-5139)
(B-3458; SR-1; AFCRL-66-810; AD-646878) CFSTI: HC $3.00/MF$0.65

A stellar telephotometer was designed for on-site use at stations photographing satellites with Xenon beacons. Through photometric measurement of known star in the photographic field, predictions may be made of beacon exposure through the existing atmosphere. The report presents the radiometric basis for the measurements and techniques used to correlate photometric readings with plate exposures. Author (TAB)

N67-24952# Edgerton, Germeshausen and Grier, Inc., Bedford, Mass.
ASTROGEODETIC INSTRUMENTATION AND FIELD SERVICES ENGINEERING Final Report, 20 Apr.–1 Dec. 1966
A. Lawrence Rotch and Paul B. Swenson 5 Dec. 1966 101 p refs
(Contract AF 19(628)-5139)
(AFCRL-67-0031; AD-647300) CFSTI: HC$3.00/MF$0.65

The design, fabrication, and testing of a Celestial Photometer developed to enhance the techniques of geodetic stellar photography are described. The development, fabrication, and testing of a second-generation balloon-borne optical beacon are also delineated. Additionally, the effort supplied under the general task of field engineering support is detailed. The design philosophy of the Celestial Photometer is that of supplying a calibrated telephotometer capable of measuring atmospheric extinction with an accuracy of one-fourth stellar magnitude, or better, to the geodetic stellar camera team in the field and of detecting background light noise as a function of limiting exposure to hold plate densities to an acceptable level. Predictions of optical beacon or passive satellite exposure through the existing atmosphere can be made through photometric measurement of one or more known stars in the photographic field. Author (TAB)

N67-24977# Springfield Armory, Mass.
METHODS AND CAPABILITIES OF ELECTRON MICROSCOPE FRACTOGRAPHY
John F. West 30 Jun. 1966 39 p refs
(SA-TR20-2411; AD-646579) CFSTI: HC$3.00/MF$0.65

Methods and capabilities of electron microscope fractography were investigated so that the potential use of fractography could be determined. Work of other investigators was studied, equipment was set up, and the application of two- and three-stage replication techniques was evaluated. Electron microscope fractographs made by the first method are shown. Modes of fracture are discussed and diagnostic features of each mode, visible with the electron microscope, are described with references to pertinent literature. Characteristic features of fracture surfaces are illustrated by electron microscope fractographs. Author (TAB)

N67-25054*# SDS Scientific Data Systems, Pomona, Calif.
IMPROVED ION SOURCES
Washington, NASA, May 1967 61 p refs
(Contract NAS5-3453)
(NASA-CR-7754) CFSTI: HC$3.00/MF$0.65 CSCL 20F

A study was performed of ion sources having a magnetically aligned electron beam, and which are compatible with a previously designed quadrupole mass spectrometer for planetary atmospheric analysis. A primary objective was to use the rigid alignment of the electron beam to minimize electron bombardment of the ion source surfaces thereby removing one of the obstacles to stable, long-term operation. A second objective was to formulate the relationships of size, pressure, electron current and applied potentials for a simple model of a magnetic ion source in order to scale the dimensions and pressure over wide ranges. Using derived scaling factors a crossed magnetic field ion source was designed for operation at 10^{-1} torr internal pressure. A model, having an internal volume of 4.7×10^{-3} cubic centimeters and tunnel apertures of 0.0025 centimeter diameter was constructed and subjected to test. Author

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N67-23513 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DETERMINATION OF THE SPECIFIC SURFACE OF POWDERS BY ELECTRON MICROSCOPY METHODS
O. N. Repkova, D. A. Vasil'kov, and R. L. Grechnyuk *In its* Certain Questions in Exptl. Phys. 26 Jul. 1966 p 131–144 refs
(See N67-23501 12-23)

Various aspects of powders are discussed, with emphasis on preparation of powders for electron-microscopic research, a method of measuring areas of buckled particles, and determining the specific surface of powders. The destruction of powder lumps in a glass atomizer is described, and diagrams are included of the apparatus. The estimation of the surface of the particles by the

areas of their projections is discussed, as well as determination of the granulometric composition of powders. Two methods are considered for the determination of the specific surface of powders: (1) by area projection of the particles measured by weighing, planimeter, or measuring on the millimeter grid and (2) by area projection of the particles, determined by measurement of the linear dimensions, taken in two mutually perpendicular directions. L.E.W.

N67-23517# Rock Island Arsenal Lab., Ill. Manufacturing Technology Div.
REVIEW OF THE POWDER METALLURGY PROCESS
Jul. 1966 153 p refs
(AD-645456) CFSTI: HC $3.00/MF $0.65

This journal is intended to emphasize and familiarize design, procurement and production activities of the Army Materiel Command with the basic concepts of the powder metallurgy process and its potential applications. It is especially addressed to those activities which are not presently utilizing the various applications and techniques of the methodology. The present state of the Art/Science is presented to encourage wider use and acceptance of the process where it can serve to improve the competitive base of the Production Base Support Program. TAB

N67-23589# Oerlikon Elektrodenfabrik Eisenberg G. m. b. H. (West Germany).
WELDED CONNECTION MADE FROM THICK HIGH-STRENGTH STEEL: TESTS USING FRACTURE CRITERIA BASED ON NEW CONCEPTS AND THE INFLUENCE OF STRAIN RATE Quarterly Report, Apr.–Jun. 1966
Jun. 1966 126 p refs Transl. into ENGLISH from German
(EURAEC-1712; EUR-2894; QR-3) CFSTI: HC $3.00/MF $0.65

Investigations were made of the influence of notch radius of a notched bar test piece on test results. Oscillographic recordings were made of force/space curves for fracture of Coheracy test pieces. Correlations were made between Robertson and Coheracy results, using steels that were already subjected to a Robertson test. Results are presented in tables and graphs. NSA

N67-23649*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MATERIALS
D. B. Fischbach *In its* Supporting Res. and Advanced Develop. 28 Feb. 1967 p 121–138 refs (See N67-23641 12-11)

Carbon and graphite, nonmagnetic interconnect material for welded structures, microcircuit welding, sterilization of impact liners, and high efficiency spacecraft structures are considered in several investigations related to materials development. Deformation research techniques, distribution of plastic deformation, and stress dependence of creep are detailed for pyrolytic carbons. In discussing spacecraft structures, it is concluded that present-day beryllium technology can be used in components that are stressed in comparison and uniaxial tension; and that composite technology has not resulted in a combination of material, process, and application that is really outstanding. M.W.R.

N67-23667*# National Aeronautics and Space Administration, Washington, D. C.
NONDESTRUCTIVE TESTING: TRENDS AND TECHNIQUES
1967 132 p refs Proceedings of the 2d Techno. Status and Trends Symp., Marshall Space Flight Center, 26–27 Oct. 1966
(NASA-SP-5082) CFSTI: HC $3.00/MF $0.65 CSCL 13H

Conference papers are presented on nondestructive testing techniques using infrared microscopy, ultrasonic emission detection, and X-ray television. For individual papers see N67-23668–N67-23676.

N67-23669*# National Aeronautics and Space Administration, Washington, D. C.
THE NONDESTRUCTIVE EVALUATION OF ADHESIVE BONDED COMPOSITE MATERIALS
W. N. Clotfelter *In its* Nondestructive Testing: Trends and Techniques 1967 p 15–29 refs (See N67-23667 12-15)

Water-coupled impedance, contact impedance, through-transmission air-coupled impedance, and eddy-sonic nondestructive techniques are described for the testing of composite materials used in launch vehicles and aircraft. All but the air-coupled method are found to be feasible for determining complete bonding in these adhesive materials. Composites of plastic-core-metal faceplate can be tested rapidly with the low frequency contact impedance method, and any defective areas can be examined more carefully with the high frequency water-coupled method to determine the exact interface at which the debond occurs. The eddy-sonic method is recommended for evaluating dual seal insulation because it can locate all debonds from a single side. With further development, the air-coupled technique could be used to increase the speed of evaluating large tanks or similar structures. This method places a single source of low frequency sound at the center of the large tank in order to scan the outside for defects. M.W.R.

N67-23670*# National Aeronautics and Space Administration, Washington, D. C.
ULTRASONIC ANALYSIS OF COLD-ROLLED ALUMINUM
R. L. Gause *In its* Nondestructive Testing: Trends and Techniques 1967 p 31–42 (See N67-23778 12-15)

Shear wave bifringence, a technique based on ultrasonics, is considered as a means of detecting and analyzing the residual or internal stresses in spacecraft materials and maximizing payload and minimizing redundant structural weight. Wave bifringence, which occurs only if the medium is anisotropic and if the direction of the particle motion does not coincide with a principal axis, is the double refraction of a shear wave that is associated with the breaking up of the wave into two components that are transmitted through the medium at right angle planes. The experimental determination of stress-induced bifringence in cold-worked aluminum is discussed, and the effects of preferred grain orientation are noted. The described laboratory method is capable of providing information on the difference between the principal residual stresses rather than on the absolute magnitude of these stresses. For field application, problems involving transducer coupling and surface preparation must be overcome. M.W.R.

N67-23671*# National Aeronautics and Space Administration, Washington, D. C.
ULTRASONIC MEASUREMENT OF STRESS IN ALUMINUM
E. C. McKannan *In its* Nondestructive Testing: Trends and Techniques 1967 p 43–54 refs (See N67-23667 12-15)

Measurement of residual stresses in the surfaces of aluminum materials is considered through the use of an ultrasonic technique that can penetrate far below the oxide layer; and the effects of varying the mechanical, chemical, crystalline, or electronics states is being studied. The developed equipment is being miniaturized to fit the electronics into a portable package, and a small precision transducer with sending and receiving crystals in one housing was developed. Causes of residual stresses are described, along with fatigue and stress corrosion in structural materials. Test methods for making the surface measurements are detailed. M.W.R.

N67-23672*# National Aeronautics and Space Administration, Washington, D. C.
AUTOMATED ULTRASONIC SCANNING BY TRIANGULATION METHOD
Robert L. Brown *In its* Nondestructive Testing: Trends and Techniques 1967 p 55–60 (See N67-23667 12-15)

An acoustic spectrometer system is described for ultrasonic nondestructive testing in space vehicles by a triangulation method. This is a pulsed system in which one transducer is the transmitter and one or more transducers receive information in the form of ultrasonic energy scattered from flaws. There are five transducers, and all of them can be programmed to act as either transmitters or receivers. Instead of shock excitation by single pulses, the transducers are driven by widely spaced pulse bursts of variable amplitude, duration, and spacing; and the burst frequency is independent of pulse spacing. The system has a time-dependent gate that can be set to receive scatter from the intersect point and can also block scatter from other parts of the plate. This aids in suppressing background noise and raising intelligibility of the flaw signal. The system is designed for highly automated operation, and primary reliance for flaw detection is on a spectrum analyzer. M.W.R.

N67-23673*# National Aeronautics and Space Administration, Washington, D. C.
ULTRASONIC EMISSION DETECTOR EVALUATION OF STRENGTH OF BONDED MATERIALS
James B. Beal *In its* Nondestructive Testing: Trends and Techniques 1967 p 61–78 refs (See N67-23667 12-15)

Development of nondestructive techniques for determining bond strengths is reviewed. Following a literature search of state-of-the-art techniques, the nature of bonding was investigated to determine what properties affect adhesion bond strength and what nondestructive technique best measures these strength properties. A photomicroflaw technique, developed to simulate poor bond strength through controlled surface contamination, involves the coating of specimen surfaces with a photosensitive emulsion and exposing the surface to an intense light source through a guide. The importance of proper process control during bonding operations and the effects of bondline contamination on bond strength are stressed. Equipment evaluation testing is reported, and the advantages of a developed ultrasonic emission detector are noted. This detector is applicable to metal-to-metal and metal-to-nonmetal bonds in laminate and sandwich core structures. Operation of the detector, a heterodyne ultrasonic receiver operating in the 26 to 36 kHz range, is detailed. M.W.R.

N67-23674*# National Aeronautics and Space Administration, Washington, D. C.
X-RAY TELEVISION TECHNIQUES FOR NONDESTRUCTIVE TESTING
Michael F. Nowakowski *In its* Nondestructive Testing: Trends and Techniques 1967 p 79–97 refs (See N67-23667 12-15)

A semiautomated X-ray television system is described that utilizes a conventional X-ray generator in conjunction with an X-ray sensitive vidicon tube to produce a picture on a television screen. Most of the disadvantages of conventional radiographic inspection systems are eliminated by the system that can perform inspection on a real time basis and thereby expedite decision making and reduce paper work. A comparison is offered between conventional film and this X-ray television technique, which is considered particularly useful for failure analysis. Other applications noted are the monitoring of welding bulkhead seams for space vehicles, ships, or submarines; the operation of watches or other timing mechanisms; and the detection of binding or misalignment in relay contacts and valves. M.W.R.

N67-23676*# National Aeronautics and Space Administration, Washington, D. C.
NONDESTRUCTIVE TESTING—PREDICTIONS OF THE FUTURE
Robert W. Neuschaefer *In its* Nondestructive Testing: Trends and Techniques 1967 p 113–123 refs (See N67-23667 12-15)

Assurance of hardware interrogation to the desired quality levels and development of faster methods are discussed in relation to nondestructive testing techniques for the future. New applications mentioned are the continuous monitoring of critical aircraft structures for fatigue testing, ultrasonic visualization of various internal organs of the human body, and damage assessment and repair in space and lunar environments. M.W.R.

N67-23686# Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material- und Festkoerperforschung.
ELECTRON BEAM WELDING AND ITS APPLICATION IN REACTOR TECHNOLOGY [DAS ELEKTRONENSTRAHL-SCHWEISSEN UND SEINE ANWENDUNG IN DER REAK-TORTECHNIK]
Willy Schoibe Feb. 1966 36 p refs *In GERMAN* Supported in part by EURATOM
(KFK-404) CFSTI: HC $3.00/MF $0.65

The specifications for welds in reactor technology are briefly indicated and the weldability of the construction materials is discussed. The principle of electron beam welding is discussed and an electron beam welding installation is described. The uses of electron beam welding in the fabrication of components for fast breeder reactors are described, and welding of Ni-containing and Ni-base alloys, Ni-Cr alloys, Mo alloys, and V alloys is illustrated by examples. NSA

N67-23728# Oak Ridge National Lab., Tenn.
CODES, SPECIFICATIONS AND ACCEPTANCE STANDARDS FOR WELDMENTS
Edward C. Miller 28 Sep. 1966 19 p Presented at the Symp. on Weld Imperfections, Palo Alto, Calif.
(Contract W-7405-ENG-26)
(ORNL-P-2615; CONF-660936-1) CFSTI: HC $3.00/MF $0.65

A general description of problems confronting industry, users, and governmental regulatory agencies in development of meaningful and workable welding codes and standards is presented. Necessity for correlation between hydrostatic, radiographic, and ultrasonic tests, and magnetic particle and penetrant examination is stressed. The limitations of each method of inspection are appraised. NSA

N67-23737# Soreq Research Establishment, Israel Atomic Energy Commission, Yavneh.
FORCE CYCLE OF VACUUM GASKET SEALS
A. Roth and A. Inbar Jul. 1966 32 p refs Presented at the 13th Symp. of the Am. Vacuum Soc., San Francisco, Oct. 1966
(IA-1089; CONF-661038-1) CFSTI: HC $3.00/MF $0.65

The method of "sealometry" recently developed for the analysis of gasket seals has shown that an appropriate representation of the force cycle of a vacuum gasket seal gives multilateral information on the factors influencing it. The various types of force cycles are discussed and the analytical correlation between the shape of the cycle and the phenomena determining the sealing effect is shown. A graphical method for plotting the releasing path of the cycle from the tightening path, and vice versa, is given. Experimental results are compared with calculated values. Standard parameters are proposed for describing the force cycle, and the most characteristic cycle shapes are presented. The use of the force cycle in establishing the suitability of seals for specific purposes (repeated opening, baking, cryogenic, etc.) is discussed.
Author (NSA)

N67-23941 Joint Publications Research Service, Washington, D. C.
SOVIET EFFORTS ON SHIPBOARD NOISE REDUCTION AND CONTROL
13 Feb. 1967 25 p refs Transl. into ENGLISH from Sudostroyeniye (Leningrad), no. 11, Nov. 1966 p 5–10, 14–18
(JPRS-39876; TT-67-30524) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. THE SITUATION AND TASKS IN CONNECTION WITH NOISE CONTROL OF SHIPS I. I. Klyukin p 1–12 refs (See N67-23942 12-15)

2. REDUCING NOISE ON SERIES DIESELS OF THE ZAPOROZH'YE TYPE M. I. Rzhavskiy p 13–20 refs (See N67-23943 12-15)

N67-23942 Joint Publications Research Service, Washington, D.C.

THE SITUATION AND TASKS IN CONNECTION WITH NOISE CONTROL ON SHIPS

I. I. Klyukin *In its* Soviet Efforts on Shipboard Noise Reduction and Control 13 Feb. 1967 p 1–12 refs (See N67-23941 12-15)

Methods for reducing noise and for eliminating noise hazard to personnel are reviewed based on existing techniques and a literature survey. Considered are measures to lower the noise level of engines, turbines, and generators; soundproofing of walls; sound absorption; vibration insulation; and various materials used in noise reduction. The rational placement of ship personnel compartments is briefly discussed. K.W.

N67-23943 Joint Publications Research Service, Washington, D.C.

REDUCING NOISE ON SERIES DIESELS OF THE ZAPOROZH'YE TYPE

M. I. Rzhavskiy Soviet Efforts of Shipboard Noise Reduction and Control 13 Feb. 1967 p 13–20 refs (See N67-23941 12-15)

Measures for reducing the noise level aboard this type of vessel are described. This diesel-powered barge has two 400-hp, 500-rpm main engines and two 50-kW auxiliary diesel generators. The crew compartments are astern in a superstructure above the engine rooms, and tests had established that the noise exceeded the acceptable level. Steps taken to reduce the noise included enclosing of engines and shafts in sound-proof housings, installation of panels of various materials, application of coatings and concrete to the hull, and installation of additional layers on decks and ceilings. The measures were effective in reducing the noise levels to acceptable norms. K.W.

N67-23953# Bureau of Mines, Albany, Oreg. Albany Metallurgy Research Center.

METALLURGY PROGRESS REPORT, NO. 31 Quarterly Report, Apr. 1–Jun. 30, 1966

30 Jun. 1966 54 p refs

(Contract AT(11-1)-599)

(USBM-RC-1249) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. HAFNIUM CARBIDE R. A. Beall and R. P. Adams p 1–12 (See N67-23954 12-15)

2. THORIUM ALLOY SYSTEMS H. J. Kelley and S. A. O'Hare p 13–16 ref (See N67-23955 12-17)

3. COLD-MOLD INDUCTION MELTING R. A. Beall and P. G. Clites p 17–18 ref (See N67-23956 12-15)

4. INVESTIGATION OF THE SYSTEM UC-UN-UO H. J. Kelly, J. L. Henry, D. L. Paulson, and R. Blickensderfer p 19–24 ref (See N67-23957 12-17)

5. W-RE-MO ALLOY DEVELOPMENT H. J. Kelly and G. Asai p 25–39 ref (See N67-23958 12-15)

N67-23954# Bureau of Mines, Albany, Oreg.

HAFNIUM CARBIDE

R. A. Beall and R. P. Adams *In its* Met. Progr. Rept. 30 Jun. 1966 p 1–12 (See N67-23953 12-15)

The purpose of this work is to develop equipment and techniques for melting and spin-casting specimens of high-melting-point metal-carbon alloys for property studies at elevated temperatures. Trial runs were made to explore operating variables and parameters of a carbide casting furnace using graphite electrodes. Thermal expansion, hot-hardness, and air-oxidation tests were conducted with HfC, 41 ZrC, TiC, TaC, and CbC specimens. Quality of the castings was determined by radiography and visual inspection. Impurity levels were spectrographically determined. Test results are presented in tables. K.W.

N67-23956# Bureau of Mines, Albany, Oreg.

COLD-MOLD INDUCTION MELTING

R. A. Beall and Philip G. Clites *In its* Met. Progr. Rept. 30 Jun. 1966 p 17–18 ref (See N67-23953 12-15)

The purpose of the project was to develop a furnace for induction melting of reactive metals in a water-cooled crucible. Efforts were made to enlarge the ingot capacity of the equipment, to improve the quality of the ingots, and to adapt the system to a motor-generator power supply. The power unit has a 75-kW, 9600-cycle output and a maximum output voltage of only 450 V. Since the low frequency of this power unit proved inadequate for heating the metal in the melting units designed for use with the radio-frequency power supply, a number of modifications were studied. Test heating of a titanium sample to 1350° C in air at approximately 30 kW input power is described. Sample capacity of the melting units is 4 inch diameter, 3/4 inch thick. K.W.

N67-23958# Bureau of Mines, Albany, Oreg.

W-RE-MO ALLOY DEVELOPMENT

Hal J. Kelly and Gene Asai *In its* Met. Progr. Rept. 30 Jun. 1966 p 25–39 ref (See N67-23953 12-15)

The objective of this project has been to prepare tungsten alloy sleeves which can be extruded and drawn into engineering-quality tubing. Evaluation of three lots of prealloyed W-25Re powders showed that individual particles are alloyed to various degrees and that these small-particle powders can be sintered at temperatures as low as 2000° C to obtain homogeneous single phase structures. Forty-five kilograms of rhenium were incorporated into 48 sintered W-25Re and W-Re-Mo alloy sleeves. Data obtained for these sleeves included density, composition, and impurity. The examination and analysis of arc-melted W-25Re tube shell extrusions and of pressed prealloyed W-25Re sleeves is discussed. Reported is also work toward the recovery of W-Re alloy scraps. K.W.

N67-23996# Technische Hogeschool Twente, Enschede (Netherlands).

THE MEASUREMENT AND EXPLANATION OF THE CHARACTERISTICS OF A HYDROSTATIC SCREW-MOTOR [HET METEN EN VERKLAREN VAN DE KAR KARAKTERISTIEKEN VAN EEN HYDROSTATISCHE WORMMOTOR]

Henricus Hubertus van den Kroonenberg (Ph.D. Thesis) 15 Nov. 1966 171 p refs In DUTCH; ENGLISH summary

CFSTI: HC $3.00/MF $0.65

The characteristics of the loss coefficients occurring in hydraulic pumps and motors according to the Schlosser mathematical model are explained. These characteristics are obtained from measurements on a screw motor. The viscosity pump and motor are discussed, because in the gaps of positive displacement pumps and motors, phenomena appear which are analogous to the action of viscosity pumps and motors. The screw motors selected for measurements because of the absence of many interfering effects. The test equipment is described and the properties of the screw motor enumerated. The effect of a series connection of a viscosity dependent resistance and a density dependent resistance is discussed. The series connection causes a deviation with regard to the mathematical model as the model is designed for a parallel

connection of a viscosity and a density dependent resistance. As a particular case of resistances connected in series, the internal resistance of hydraulic pumps and motors is discussed. In the model, the hydraulic fluid is considered as isoviscous and incompressible. The deviations, due to the viscosity-temperature relation of hydraulic fluids, appear to agree with theory. Author

N67-24242# Autonetics, Anaheim, Calif.
MICROSTRUCTURAL TOPOGRAPHY BY INTERFERENCE CONTRAST MICROSCOPY
D. Medellin and C. Y. Ang *In* Rocky Flats Div., Dow Chemical Co. Advan. in Metallog. 20 Oct. 1966 p 1–10 refs (See N67-24241 12-17)

Conventional light microscope methods are inadequate for detailed observations of surface irregularities having only slight variations in vertical dimensions and no apparent variations in reflectivity. The Nomarski interference contrast equipment provides a surprisingly clear and virtually three-dimensional image of the microstructural topography of surfaces. When coupled with the replica techniques, the interference contrast microscopy has been found to be extremely useful in the study of surfaces of thin films and bulk specimens, and in providing permanent records of various processing or experimental stages. Author

N67-24243# Oak Ridge National Lab., Tenn.
MICROSTRUCTURAL DISCRIMINATION BY DEPOSITION OF SURFACE FILMS
J. O. Stiegler and R. J. Gray *In* Rocky Flats Div., Dow Chemical Co. Advan. in Metallog. 20 Oct. 1966 p 11–17 refs Sponsored by AEC (See N67-24241 12-17)

It has been observed that surface films of uniform thickness deposited by vacuum evaporation also distinguish different phases due to an optical phase shift at surface film–metal interface that depends on the optical constants of the film and the underlying metal. This extends the range of phase identification by surface films to all metal alloy systems. Experimental details for employing this technique, called deposition etching are given, along with some examples of the use of the technique in resolving fine structures and in determining the amounts and distributions of phases. Author

N67-24244# National Lead Co. of Ohio, Cincinnati.
THE IDENTIFICATION OF INCLUSIONS IN URANIUM METAL BY COLOR METALLOGRAPHY
E. L. Schaich *In* Rocky Flats Div., Dow Chemical Co. Advan. in Metallog. 20 Oct. 1966 p 18–25 refs (See N67-24241 12-17)

Techniques have been developed to permit optical identification of various phases and inclusions in uranium metal by controlled oxidation or heat tinting. In this method the various phases are caused to assume characteristic colors by which they can be identified. Particles that can be distinguished at present include UC, U_6Fe, U_3Si, and UAl_2. Sample preparation, heat tinting procedures, and identification are discussed. Author

N67-24246# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
POST-IRRADIATION METALLOGRAPHIC EXAMINATION OF ARC-CAST HYPOSTOICHIOMETRIC URANIUM MONOCARBIDE
J. L. Arnold *In its* Advan. in Metallog. 20 Oct. 1966 p 38–42 (See N67-24241 12-17)
(Contract AT(11-1)-GEN-8)

Hypostoichiometric uranium carbide fuel samples that had operated at very high temperatures (1600°–2500°C) for a short period of time had a structure which included large voids and metallic uranium in the grain boundaries, as well as numerous fine voids within each UC grain. In addition, the material adjacent to certain grain boundaries appeared relatively free of voids. These grain boundaries were located on the side of the grains nearest the axial center line of the samples. This feature of the microstructure of the uranium carbide is attributed to a grain boundary sweeping action as the grain boundaries migrated toward the center of the sample under the influence of the temperature gradient. Similar features were not found in samples that were irradiated at centerline temperatures in the range of 850°–1000°C. Author

N67-24459*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
FRICTION CHARACTERISTICS OF SINGLE-CRYSTAL AND POLYCRYSTALLINE RHENIUM IN VACUUM (10^{-11} TORR)
Donald H. Buckley Washington, NASA, May 1967 16 p refs
(NASA-TN-D-3955) CFSTI: HC$3.00/MF$0.65 CSCL 11F

An investigation was conducted in vacuum to determine the friction characteristics of rhenium in its single-crystal and polycrystalline forms. Experiments were conducted with a hemispherical rider sliding on a flat disk at 0.001 to 700 centimeters per second at ambient pressures to 10^{-11} torr. Polycrystalline rhenium was examined sliding on itself at temperatures to 680°C and loads to 2500 grams. Single-crystal experiments were conducted at 20°C for loads to 1000 grams with the basal (001) plane sliding in the $[11\bar{2}0]$ and $[10\bar{1}0]$ directions and the prismatic plane $(10\bar{1}0)$ sliding in the $[11\bar{2}0]$ and [0001] directions on polycrystalline rhenium. The results of this investigation indicate that the friction characteristics of rhenium are highly dependent on its anisotropic nature. Comparative friction experiments with tantalum indicate that cubic tantalum exhibits high friction coefficients and welding in vacuum. With rhenium, no evidence of cold welding was observed. Friction data for rhenium correlate with the relation established for lattice parameters and the friction coefficients of hexagonal metals. The marked work-hardening characteristics of rhenium influenced both single-crystal and polycrystalline friction. Author

N67-24474*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
WEAR AND FRICTION OF IMPREGNATED MECHANICAL CARBONS AT TEMPERATURES TO 1400°F (760°C) IN AIR OR NITROGEN
Thomas N. Strom, Gordon P. Allen, and Robert L. Johnson Washington, NASA, May 1967 19 p refs
(NASA-TT-D-3958) CFSTI: HC$3.00/MF$0.65 CSCL 11B

Friction and wear tests were conducted with some impregnated mechanical carbons to determine their performance at high temperatures. Loaded hemispherically tipped carbon riders were in sliding contact with rotating chromium-plated disks in air or in nitrogen. A surface speed of 10,000 feet per minute (50.8 m/sec), a load of 1000 grams, and temperatures to 1400°F (760°C) were used. Results indicate that impregnated mechanical carbons can function satisfactorily in air to 1200°F (649°C). Performance of the materials was generally better in nitrogen than in air at 1200°F (649°C). Oxidation plays an important role in friction and wear behavior at high temperatures. Author

N67-24628*# National Research Corp., Cambridge, Mass. Norton Exploratory Research Div.
PROPERTIES OF POWDER GROUND IN ULTRAHIGH VACUUM Final Technical Report, 24 Aug. 1965–23 Aug. 1966
P. Blum, J. R. Roehrig, and M. J. Hordon Mar. 1967 48 p refs
(Contract NAS1-5347)
(NASA-CR-66276) CFSTI: HC$3.00/MF$0.65 CSCL 13H

A preliminary investigation was conducted into the properties of lunar soil by simulating the comminution of the rock in ultrahigh vacuum (UHV). Previous simulation studies are reviewed, and the need for vacuum comminution is discussed. Apparatus was

constructed for pulverizing the igneous rock in ultrahigh vacuum to permit determination of the properties of powders produced with atomically clean particle surfaces. Both grinding components were made of basalt. Basalt powder was produced while maintaining pressures in the low 10^{-9} and 10^{-8} Torr ranges; this required extensive rock baking prior to comminution, causing a 0.66% weight loss. Comparative data are presented on the properties and behavior of basalt powder ground in vacuum and in air. It was concluded that simulation of lunar soil surface cleanliness by UHV in igneous rock comminution is feasible. M.G.J.

N67-24651# Marine Engineering Lab., Annapolis, Md.
SURVEY OF PRESENT INFORMATION ON ELASTOHYDRODYNAMIC LUBRICATION OF GEARING
L. G. Schneider Feb. 1967 70 p refs
(MEL-369/66; AD-646896) CFSTI: HC $3.00/MF $0.65

The report is a survey of numerous published theoretical and experimental investigations in elastohydrodynamic lubrication with the intent of establishing their applicability to design and to lubrication investigations related to future high performance Navy gearing. While great progress in understanding the parameters of importance in elastohydrodynamic lubrication has been made, workable solutions for use in normal design are available only for limited conditions which are realized in rolling contact when little or no sliding occurs. In gearing, this condition exists only at the pitch point so that theoretical prediction of oil-film thickness becomes increasingly overly optimistic as tooth contact distance from the pitch line (and thus sliding velocity) increases. Author (TAB)

N67-24663# Southwest Research Inst., San Antonio, Tex.
FUNDAMENTAL INVESTIGATION OF LIQUID-METAL LUBRICATED JOURNAL BEARINGS Topical Report No. 2
R. A. Burton and Y. Hsu 12 Jan. 1967 88 p
(Contract AT(11-1)-1228)
(SWRI-1228P8-32) CFSTI: HC $3.00/MF $0.65

By reference to new experimental data and by numerical calculations which exploit and extend the applicability of one of the more promising techniques, the behavior of crossed Couette and pressure flows can be predicted with good accuracy. Experimental results showed large pressure changes near discontinuities in the bearing surfaces such as found in stepped pads and in spiral-groove bearings. Generalizing the pressure rise data for the entry region of pads, this effect as a boundary condition in computations of the performance of tilted pads was discussed. In view of the foregoing critical discussions, it seems that the calculated performance is realistic. The fact that pad-tipping is predicted by these calculations, under some circumstances, should serve as a warning to designers. The negative pressure observed in stepped pads and spiral-groove configurations indicates conditions under which films would be expected to cavitate. Since this may also lead to malfunction of the bearing or seal, such observations are expected to lead, ultimately, to statements of design limitations. They also serve to provide explanations of previously observed film-breakup in such configurations as the screw-thread seal, a topic which has been the subject of considerable speculation and mystery. Author (NSA)

N67-24664# California Univ., Berkeley. Lawrence Radiation Lab.
FILTRATION STUDIES WITH ULTRAFINE PARTICLES
Ashok Kumar Bhagat and Charles R. Wilke Sep. 1966 110 p
(Contract W-6405-ENG-48)
(UCRL-16574) CFSTI: HC $3.00/MF $0.65

A new continuous filter was developed to filter very fine particles of about 1 to 6 micron size without cake formation. The slurry is filtered through a rotating filter membrane and solids are rejected as a thick slurry. A general theory was also developed to predict the limiting filtration rate for such a filter. This theory considers the centrifugal force on the particles and their diffusion in a highly turbulent field ($6\times10^5<Re_D<11\times10^5$). Shear stress on the membrane and the drag coefficients were also measured and compared with the available data in the literature. Limiting filtration rates up to 33×10^{-3} ml/sec/cm^2 were obtained for the systems considered. Agreement of the correlation with experimental data for 1.3 micron polystyrene latex spheres and 6 to 14 micron styrene divinylbenzene copolymer latex spheres is within 35%. Author (NSA)

N67-24715# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A DEVICE FOR INDUCTION ANNEALING OF AN ALUMINUM WIRE OR FILAMENT DURING DRAWING OR TWISTING
V. Ye. Gorbunov, V. Ya. Alekhin, and A. A. Lazerev 7 Nov. 1966 5 p Transl. into ENGLISH from Russian Patent no. 158916 (Appl. no. 794700/22-2, 22 Nov. 1963) 1 p
(FTD-HT-66-662; AD-646379) CFSTI: HC $3.00/MF $0.65

A device is described for the induction annealing of aluminum wire or filaments during drawing or twisting which includes a toroidal transformer and guiding rollers. To reduce extration during the annealing process two multigroove drive drums on which several loops of wire or filament are located before the annealing branch and after it. Author (TAB)

N67-24746# IIT Research Inst., Chicago, Ill. Technology Center.
DEVELOPMENT OF A PROCESS FOR PNEUMATIC EXTRUSION OF METALS Quarterly Report
M. H. Zoiss Jun. 1966 26 p
(Contract DA-19-066-MAC-307(X))
(AMRA-CR-66-04/2; QR-2; AD-646992) CFSTI: HC $3.00/MF $0.65

The report details the present status of the hydraulic-pneumatic circuit, the gas accumulators and the extrusion chamber assembly. This report also presents the proposed instrumentation to be used for stress condition monitoring during operation of the extrusion unit. Author (TAB)

N67-24748# IIT Research Inst., Chicago, Ill. Technology Center.
DEVELOPMENT OF A PROCESS FOR PNEUMATIC EXTRUSION OF METALS Quarterly Report, Jun. 15–Sep. 15, 1966
M. H. Zoiss Sep. 1966 22 p refs
(Contract DA-19-066-MAC-307(X))
(AMRA-CR-66-04/3; QR-3; AD-646993) CFSTI: HC $3.00/MF $0.65

The report details the present status of the hydraulic-pneumatic circuit, the gas accumulators and the extrusion chamber assembly. Appendix I contains the pressure, volume and precharge relationships for the pneumatic extrusion apparatus. Author (TAB)

N67-24768# Frankford Arsenal, Philadelphia, Pa.
ULTRASONIC IN-PROCESS INSPECTION OF RESISTANCE SPOT WELDS Final Report
George E. Burbank and Wallace D. Taylor Apr. 1966 49 p refs
(R-1811; AD-633340) CFSTI: HC $3.00/MF $0.65

In the continued evaluation of the in-process ultrasonic approach to the nondestructive inspection of resistance spot welds, ultrasonic through-transmission measurements were extended to several types of metals to establish signal sensitivity and behavior with respect to metallurgical changes. In addition, the test results are reviewed from the standpoint of meaningful trends and reproducibility required for the development of go–no go or absolute measurement type quality control devices. Author (TAB)

N67-24768# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

A METHOD OF ELECTRODE SLAG CASTING OF INGOTS

B. Ye. Paton and D. A. Dudko 12 Dec. 1966 7 p Transl. into ENGLISH from Russian Patent no. 168743 (Appl. no. 817797/22-2, 6 Feb. 1963) 2 p

(FTD-HT-66-672; AD-647722) CFSTI: HC $3.00/MF $0.65

During electrode slag casting of ingots, the liquid metal and, when necessary, the liquid slag are poured into the mold or the crystallizer through a hollow expendable or nonexpendable electrode. This improves the quality of the metal and the surface of the casting, increases the yield of suitable pieces and increases productivity. Author (TAB)

N67-24779# Whittaker Corp., San Diego, Calif. Narmco Research and Development Div.

EXOTHERMIC SPACE BONDING SYSTEM Final Technical Report, 1 Jun. 1965–28 Feb. 1966

Rodney A. Jones and Glenn H. Sievert Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Aug. 1966 65 p refs

(Contract AF 33(615)-2814)

(AFAPL-TR-66-63; AD-646670) CFSTI: HC $3.00/MF $0.65

The report covers the development of a system, including materials, design, and techniques, for attaching adhesive pads to the exterior surface of spacecraft. The purpose of these pads is to provide attachment points for astronauts and their equipment while carrying out maintenance and repair functions in space. The pads consist of aluminum disks of 1-1/4 in. diameter and 0.050-in. thickness with a fastening stud on one surface and a layer of thermoplastic adhesive on the other surface. A thermal pulse to soften the adhesive and produce bonding under light pressure is obtained from the reaction of a small exotherm charge, which is enclosed in an insulative housing on the back or stud-side of the pad. Vacuum bonding experiments at approximately 0.000001 Torr plus the results of bond strength tests over the range from -100F to 250F are described. Adhesive bond strengths of nearly 900 psi at room temperature were obtained on aluminum skin specimens. Design strength objectives of more than 100 psi were achieved over the entire temperature range. Also described is the development and test of an exotherm heating unit for preheating spacecraft structure skins before pad bonding to improve adhesion and operational flexibility. Vacuum exposure tests on organic adhesive bonded specimens indicate suitability for extended use without degradation of adhesive strength. Author (TAB)

N67-24801# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ADOPTING THE MANUFACTURE OF BENT ROLLING PROFILES OF FINNED PLATE TYPE DURING CALIBRATION WITH RESIDUE OF WAVE PREPARATION [OSNOYENIYE PROIZVODSTVA GIUTYKH PROFILEY PROKATA TIPA REBRISTYKH PLIT PRI KALIBROVKI OSADKOY VOLNISTOY ZAGOTOVKI]

I. S. Trishevskiy, V. V. Klepanda, and E. S. Dakhnovskiy 7 Dec. 1966 17 p Transl. into ENGLISH from Sb. Nauchn. Rabot Inst. Metallofiz., Akad. Nauk Ukr. SSR (Kiev), no. 9, 1964 p 240–251

(FTD-HT-66-361; TT-67-61121; AD-647713) CFSTI: HC $3.00/MF $0.65

A roller calibration system with settling of the wavy billet was developed, which assures a considerable reduction in the thinning value of the metal in bending places, because at the formation of a wavy billet, the metal is bent by a greater radius which reduces the thickness of the elongated zone, and consequently also the thinning value. Settlement takes place because of compression of wave tops and deformation of elongation in bending points, which takes place during the stretching of the billet around the rollers. It is changed by deformation compression, which also promotes a reduction in the thinning of the metal. Obtainment of an accurate rib form of the plate and the fulfillment of arcs in rounding off places can be assured because of the settlement of the wavy billet, not in one, but in two stands to facilitate deformation of the metal during the settling. Wave formation on the edges of the band are eliminated by setting up a second settling stand to facilitate the formation condition during the settling of a wavy billet. The longitudinal narrowing of the plate should be formed in two-three last pairs of machine rollers, because with an increase in the number of stands to mold this narrowing in bending places, a reforming of the metal is obtained. TAB

N67-24815# Battelle Memorial Inst., Columbus, Ohio.

FABRICATION OF EXPERIMENTAL FLUX-CORED FILLER WIRES Final Report

Douglas L. Cheever and Robert E. Monroe Watertown, Mass., Army Mater. Res. Agency, Nov. 1966 19 p

(Contract DA-01-19-066-D6-01827(X))

(AMRA-CR-66-11(F); AD-647246) CFSTI: HC $3.00/MF $0.65

Twelve different compositions of experimental flux-cored filler wire were fabricated for welding studies using high-purity iron sheath and iron powder. The wire was produced from strip using a forming mill and drawn to a final 0.091-inch diameter. This report contains a description of the materials and methods used to produce the wire. Author (TAB)

N67-24842# Naval Civil Engineering Lab., Port Hueneme, Calif.

WINDOWS FOR EXTERNAL OR INTERNAL HYDROSTATIC PRESSURE VESSELS. PART I: CONICAL ACRYLIC WINDOWS UNDER SHORT-TERM PRESSURE APPLICATION

J. D. Stachiw and K. O. Gray Jan. 1967 104 p refs

(NCEL-TR-512; AD-646882) CFSTI: HC $3.00/MF $0.65

Conical acrylic windows for fixed ocean-floor structures were placed under short-term loading (pressurization from zero to failure at a fixed rate). The windows, of different thicknesses and different included conical angles, were subjected to various applied pressures, and their subsequent behavior was studied. Acrylic windows, in the form of truncated cones with included angles of 30, 60, 90, 120, and 150, were tested to destruction at ambient room temperature by applying hydrostatic pressure to the base of the truncated cone at a continuous rate of 650 psi/min. The pressure at which the windows failed and the magnitude of displacement through the window mounting at different pressure levels were recorded. The ultimate strength of the conical windows (denoted by the critical pressure at which actual failure occurred) was found to be related both to thickness and included conical angle. Graphs are presented defining the relationships of critical pressure versus thickness-to-diameter ratio, and pressure versus magnitude of displacement for the windows. Nondimensional scaling factors for critical pressure and displacement applicable to large-diameter windows are discussed and presented in graphic form. Author (TAB)

N67-24888# Aberdeen Proving Ground, Md. Coating and Chemical Lab.

SINTERED IRON BRAKE CYLINDER PISTONS Final Report

Charles B. Jordan Nov. 1966 16 p refs

(CCL-216; AD-646222) CFSTI: HC $3.00/MF $0.65

The study consisted of a comparison of Sintered Iron Pistons versus Aluminum Pistons in hydraulic brake cylinders under conditions encountered in packaging, standby storage, stroking tests and vehicle operation. While corrosion, staining and gumming are experienced with Aluminum Pistons, corrosion and staining are eliminated and gumming greatly reduced by Sintered Iron Pistons. Operational characteristics are improved with Sintered Iron Pistons as evidenced by reduced metal wear and almost total elimination of sediment in the Hydraulic Brake Fluid. TAB

N67-24907# Marine Engineering Lab., Annapolis, Md.
PREPARATION OF THIN FOILS FOR ELECTRON MICROSCOPY BY A ROTATING POLYTETRAFLUOROETHYLENE HOLDER
Ivan L. Caplan Feb. 1967 17 p refs *Its* Assignment-87-119
(MEL-34/67; AD-647133) CFSTI: HC$3.00/MF$0.65

A modified technique has been developed for preparation of thin foil electron microscope specimens. The method eliminates premature perforation of specimens, while permitting low-voltage, low-temperature polishing. Author (TAB)

N67-24967# Springfield Armory, Mass.
RESONANT BEAM AND ULTRASONIC METHODS FOR EVALUATION OF SINTERED POWDER STEEL COMPACTS
Robert H. Brockelman 20 May 1966 32 p refs
(SA-TR19-1521; AD-646580) CFSTI: HC$3.00/MF$0.65

Results of an investigation designed to determine the practicability of evaluating the mechanical properties of sintered steel powder compacts by ultrasonic and mechanical resonance technique are described. The yield and tensile strengths of sintered prealloyed steel are correlated with sintered density, resonant frequency, sonic and ultrasonic velocity, as well as C-scan ultrasonic transmission recordings. The correlations that have been established demonstrate the effectiveness of sonic and ultrasonic methods for the nondestructive evaluation of sintered powder metals. The experimental procedures are described and the capabilities and limitations of each technique are discussed. Author (TAB)

N67-24990# Naval Avionics Facility, Indianapolis, Ind.
STANDARD HARDWARE DESIGN INFORMATION
1 Jun. 1966 218 p refs
(NAFI-TP-218; AD-647031) CFSTI: HC$3.00/MF$0.65

The publication describes the contributions to the Standard Hardware Program (SHP) by the NAFi Engineering Department on the design, the testing, the basic heat transfer theory and the layout of thin film circuits for microelectronic (including Type 3 and Type 2) modules. Author (TAB)

N67-25012*# International Information, Inc., Philadelphia, Pa.
METHOD OF OBTAINING COMPACTION PRODUCTS FROM REFRACTORY METALLIDES USING ULTRASONIC ACTIVATION [O METODIKE POLUCHENIYE KOMPAKTNYKH IZDELIY IZ TUGOPLAVKIKH METALLIDOV PRI AKTIVIROVANII ULTRAZVUKOM]
V. R. Pokryshev and V. I. Marchenko Washington, NASA, Feb. 1967 4 p refs Transl. into ENGLISH from Poroshkovaya Met., Akad. Nauk Ukr. SSR (Kiev), v. 6, no. 8, 1966 p 98–100
(Contract NASw-1499)
(NASA-TT-F-10774) CFSTI: HC$3.00/MF$0.65 CSCL 13H

The authors describe a device and a method developed by them in order to investigate the influence of ultrasonic vibrations on the processes of sintering, high-temperature pressing, and for the production of compaction products from the powders of metals and their compounds. A laboratory vacuum device is discussed and illustrated. Author

N67-25067# Argonne National Lab., Ill.
DEVELOPMENT OF TECHNIQUES FOR FABRICATION OF SMALL-DIAMETER, THIN-WALL TUNGSTEN AND TUNGSTEN-ALLOY TUBING Interim Progress Report, 1 Jan. 1964–31 Dec. 1965
W. R. Burt, D. C. Brillhart, and R. M. Mayfield Jul. 1966 36 p refs
(Contract W-31-109-ENG-38)
(ANL-7151) CFSTI: HC$3.00/MF$0.65

Progress in the fabrication of small-diameter, thin-wall W and W alloy tubing is summarized. Methods are described for producing W or W-25 wt % Re tube-blanks by double extrusion. The starting material, generally a pressed and sintered product, is in the form of a sleeve 3.17-cm OD×2.54-cm ID×≈10.2 cm long (1.25-in. OD×1.00-in. ID×≈4.0 in. long). Both initial and re-extrusion processes use the filled-billet technique. The resultant tube-blanks, ≈0.64-cm OD×0.51-cm ID×75 cm long (0.25-in. OD×0.20-in. ID×30 in. long), are structurally sound and suitable for secondary fabrication operations. Secondary fabrication operations were concentrated on the W-25Re alloy. Plug drawing emerged as an excellent technique, both for the reduction of the overall tube dimensions and for the removal of the longitudinal surface striations resulting from the filled-billet extrusion sequence. Plug drawing also obviates the need for core removal at the finished-tube size (<0.125-in. OD). Even at larger tube sizes, core removal remains a problem, and improved methods are being sought. Crack-free swage pointing of the small-diameter W-25Re tubing is difficult unless proper dies and swaging techniques are employed. Progress in this area is presented. Author (NSA)

N67-25070*# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
INVESTIGATION OF SMOOTH-BONDED METAL LINERS FOR GLASS FIBER FILAMENT-WOUND PRESSURE VESSELS Final Report, Jun. 22, 1965–Feb. 1967
J. M. Toth, Jr. and D. J. Soltysiak May 1967 131 p refs
(Contract NAS3-6293)
(NASA-CR-72165; DAC-60640) CFSTI: HC $3.00/MF $0.65 CSCL 13H

The goal of this investigation was the development of a liner-adhesive system, which when incorporated into a filament-wound pressure vessel, would withstand repeated cyclic loadings over a temperature range of +75°F to −423°F. Various adhesive systems were evaluated in preliminary coupon testing. A blended polyurethane:epoxy resin with a glass scrim cloth system was selected for further testing in a 1:1 biaxial pressure vessel. A thin aluminum liner performed well with the adhesive at −423°F, but at ambient temperature, aluminum liners and a nickel liner buckled and failed. On the basis of these results, a reorientation was made to further develop an adhesive system to satisfactorily bond the liner at both ambient temperature and −423°F. The use of a thin nylon scrim in the adhesive, in place of the glass scrim, improved the ambient temperature performance of the 70:30 blend adhesive, while at the same time, it did not cause a degradation in the −423°F performance. An 80:20 blend adhesive (with nylon scrim) also performed satisfactorily. The primary liner in all cases remained satisfactorily bonded to the structural wall. However, at −423°F, in all cases, leakage occurred through the bonded longitudinal seam. Author

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N67-23935# Westinghouse Electric Corp., Baltimore, Md.
VERSATILE LASER SIGNAL SOURCE Final Report, 1 Jun. 1965–15 Apr. 1966
I. T. Basil 15 Apr. 1966 52 p
(Contract DA-01-021-AMC-12055(Z))
(AD-645364) CFSTI: HC$3.00/MF$0.65

The fabrication and testing of a neodymium-doped glass laser oscillator-amplifier device is described, and test results and operating and maintenance information are presented. Author (TAB)

N67-24316# Library of Congress, Washington, D.C. Aerospace Technology Div.

THE GAS LASER IN A MAGNETIC FIELD

Yuri Ksander *In its* Foreign Sci. Bull., Vol. 3, No. 3 Mar. 1967 p 33–64 refs (See N67-24312 12-23)

A more comprehensive theoretical understanding of laser electrodynamics is gained through studies of the effect of the magnetic field on the operation of a gas laser. Research in this area is also valuable to the applied physicist in search of solutions to such problems as frequency tuning and stabilization, and the escalation of the laser output power. The Soviet works reviewed are strongly theoretical, giving little emphasis to applications. Author

N67-24364# United Aircraft Corp., East Hartford, Conn. Research Labs.

RESEARCH INVESTIGATION OF LASER LINE PROFILES Semiannual Report, 1 Aug. 1966–31 Jan. 1967

Anthony J. De Maria, George L. Lamb, Jr., and David A. Stetser 27 Feb. 1967 40 p refs

(Contract N00014-66-C0344; ARPA Order 306; Proj. Defender)

(F-920479-2; AD-647814) CFSTI: HC $3.00/MF $0.65

Some aspects of the theory of a gas laser recently developed by W. E. Lamb, Jr. are recast in a form which more fully displays the role played by the particle dynamics. The Wigner distribution function is used to derive kinetic equations which govern the external center of mass motion of the two-level system as well as their internal dynamics. The effect of long range forces is discussed by treating the collision integral in a manner similar to that employed in plasma kinetic theory. A modification in the criterion for the existence of a dip in the output is obtained. It is also shown that effects due to long range forces are most noticeable at long optical wavelengths and when there is a large difference between the lifetimes of the two laser levels. The experimental system for measuring the line profile of a dc excited argon laser was designed, constructed, and made operative. Preliminary data on the Lamb Dip of an argon ion laser was obtained as a function of pressure and excitation. Author (TAB)

N67-24376# Florence Univ. (Italy).

MODE SELECTION PROPERTIES OF A MANY-ELEMENT LASER

R. Pratesi and L. Ronchi-Abbozzo Oct. 1966 57 p refs

(Contract AF 61(052)-871)

(SR-4; AFCRL-67-0066; AD-647773) CFSTI: HC $3.00/MF $0.65

A theoretical analysis is carried out of the mode-selection properties of a Many Element Laser consisting of N like elements of active material separated by lossless unlike air-gaps. The gaps are assumed to be sufficiently narrow to present frequency-independent transmission and reflection coefficients. A comparison with an unsegmented resonator, with equal total length of active material and equal end-face reflectivities is performed, by using the generalized Tang Statz and de Mars theory. Experiments of mode selection in a MEL with $N = 5$, 7 and 10 like elements are reported. Author (TAB)

N67-24379# Sylvania Electric Products, Inc., Mountain View, Calif. Electronic Defense Labs.

TECHNIQUES FOR SUPER-MODE OSCILLATION Interim Engineering Report, 1 Oct.–31 Dec. 1966

Russell Targ, D. E. Caddes, J. D. Foster, J. M. French, and L. M. Osterink 31 Dec. 1966 38 p refs

(Contract AF 33(615)-2884)

(IER-8; AD-645045) CFSTI: HC $3.00/MF $0.65

An evaluation was made of the FM stabilization system, making use of the odd harmonic FM beats to achieve absolute frequency stabilization of the FM carrier with respect to the center of the atomic gain profile. The system is able to provide stabilization of better than 1 part in 10 to the 8th power on a long-term basis with no net drift in the FM spectrum. The FM laser not only can be used to give stabilized single-frequency light, but also has other applications. In particular, the FM laser without stabilization is much more suitable for use as an optical carrier than is a free-running laser. The FM process couples the modes of the laser, reducing the low-frequency noise resulting from mode competition. The GaAs laser offers the possibility for the direct production of an FM laser without the need for introducing any additional material inside the laser cavity. A population inversion leading to gain and oscillation is created in GaAs by direct current excitation. Two ways of creating the time-varying component in the materials index of refraction which is the necessary condition for FM oscillation are by the electro-optic and photo-elastic effects. TAB

N67-24488# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CERTAIN RESULTS OF COMPARING OKG ON A RUBY WITH PLANE PARALLEL AND CONFOCAL RESONATORS [NEKOTORYYE REZUL'TATY SRAVNENIYA OKG NA RUBINE S PLOSKOPARALLEL'NYM I KONFOKAL'NYM REZONATORAMI]

N. A. Sventsitskaya and L. D. Khazov 12 Dec. 1966 9 p refs Transl. into ENGLISH from Zh. Prik. Spektroskopii, Akad. Nauk Belorussk. SSR (Minsk), v. 4, no. 4, 1966 p 345–347

(FTD-HT-66-523; TT-67-61114; AD-647717) CFSTI: HC $3.00/MF $0.65

An experimental comparison of energy and of the radiation angle for lasers with plane and confocal mirrors was made. The radiation energy in the confocal resonator is 1.7 times greater than for the plane resonator. The angle of divergence of the radiation after compensation of the spherical component is 3.5 times greater, and the axial beam brightness is by an order less than for the plane resonator. Besides, for a confocal resonator more uniform energy distribution is observed, the time-dependence of the radiation of quasi-dependence pf the radiation of quasi-continuum character with superimposed regular oscillations is observed. Author (TAB)

N67-24581 Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Oberpfaffenhoffen (West Germany).

REMARKS TO THE RINGLASER AND ITS USE [BEMERKUNGEN ZUM RINGLASER UND SEINER ANWENDUNG]

F. Malota Jan. 1967 53 p refs In GERMAN; ENGLISH summary

(DLR-Mitt.-67-01) CFSTI: HC $3.00/MF $0.65

The theory of the SAGNAC-experiment is treated in terms of classical physics. The performances of a ring interferometer and a ring laser are presented and an attempt is made to explain the basic difference between the two. The effects which limit the performance of a ring laser are described. The realizable measurement range of the angular velocity and the influence of apparatus parameters on the ring laser performance are discussed. Author

N67-24831# RCA Victor Co., Ltd., Montreal (Quebec).

NOISE CONSIDERATION FOR THE DETECTION OF WEAK LASER SIGNALS

A. L. Waksberg and I. P. Shkarofsky Wright-Patterson AFB, Ohio. Aerospace Res. Labs., Sep. 1966 60 p refs

(Contract AF 33(615)-2196)

(Rept.-7-801-49; ARL-66-0181; AD-646744) CFSTI: HC $3.00/MF $0.65

A study is made of the minimum laser signal that can be detected when it is embedded in a background of black body radiation and other sources of noise. In particular, the laser source is assumed to be modulated and a phase lock or pulse coincidence

amplifier to be employed. General expressions are derived for the signal-to-noise ratio at the output of a phase lock (or pulse amplifier) for a signal immersed in noise. The types of modulation that are examined comprise sinusoidal, square wave and pulse modulation. The noise considered is that arising from black body and Bremsstrahlung radiation, thermal noise, generation, recombination noise etc.. In particular, laser noise is discussed in some detail. Finally, a Thomson scattering experiment is considered as a special case. Author (TAB)

N67-24904# Hughes Research Labs., Malibu, Calif.
SELECTIVE ACCESS LASER DISPLAY BEAM POSITIONER Quarterly Report, 1 Jun.–31 Aug. 1966
J. F. Lotspeich, W. P. Brown, Jr., and J. E. Kiefer Griffiss AFB, N. Y., RADC, Jan. 1967 72 p refs
(Contract AF 30(602)-4097)
(RADC-TR-66-617; QR-2; AD-646619) CFSTI: HC $3.00/MF $0.65

The investigation concerns the development of a selective access laser display beam positioner capable of presenting a flexible format and multicolor images on large screen map backgrounds. Basic requirements of the beam positioner are microsecond response and random deflection to any of approximately 1,000,000 resolvable spots. The results of a continuing experimental and theoretical effort toward achieving these objectives are presented. The approach is concentrated on studying the performance characteristics of an iterated electro-optic prism beam angle deflector and on establishing the limits of its resolution capability. It is believed that this type of deflector, augmented by one or two stages of binary-switched lateral beam positioner, will provide maximum optical transmission with minimum driving power. Author (TAB)

N67-25008*# National Aeronautics and Space Administration, Washington, D. C.
THE TWO-PHOTON LASER [O DVUKHFOTONNOM LAZERE]
T. M. Il'inova Feb. 1967 11 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. Fiz. Astron. (Moscow), v. 21, no. 5, 1966 p 39–47
(NASA-TT-F-10621) CFSTI: HC $3.00/MF $0.65 CSCL 20E

The stationary regime of a two-photon laser and its stability are studied. Resonance curves for the excitation of stationary oscillations are compiled. The non-stationary processes in this system are investigated in the approximation of the given field. When the excitation conditions are fulfilled, the laser emits an impulse having the frequency ω_1 (frequency of the operating transition $\omega_{21}=\omega_2$, where ω_2 is the field frequency $E_2 > E_2^{thresh}$ from an outer source). The impulse strength and its duration depend essentially on the magnitude of the field E_2. If $E_2/E_2^{thresh} \geq 1$, then the emitted impulse has a symmetrical form and its energy and duration are determined by the field E_2. In the case of $E_2/E_2^{thresh} >> 1$, the signal energy depends only on the properties of the active medium. The duration of the leading edge is determined by the magnitude of the field E_2; the duration of the trailing edge equals the damping time of the resonator at the frequency ω_1. Author

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N67-23521 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STRUCTURAL STRENGTH OF LIGHT ALLOYS AND STEELS
13 May 1966 160 p refs Transl. into ENGLISH of the Book "Konstruktsionnaya Prochnost Legkikh Splavovi Staley" Moscow, Izd. Mashinostroyeniye, 1964 p 1–168
(FTD-MT-65-92; AD-645791)

CONTENTS:

1. FATIGUE LIMIT OF ALLOY AVT AND SCALE FACTOR V. P. Kogayev, Ye. V. Glatsintov, and M. N. Stepnov p 3–15 (See N67-23522 12-17)
2. LINEAR REGRESSIONAL ANALYSIS OF RESULTS OF FATIGUE TESTS M. N. Stepnov p 17–23 refs (See N67-23523 12-17)
3. FATIGUE STRENGTH OF ALUMINUM ALLOYS DURING ASYMMETRIC CYCLE N. A. Borodin, Ye. V. Glatsintov, V. P. Kogayev, and M. N. Stepnov p 25–33 refs (See N67-23524 12-17)
4. ABOUT THE APPRAISAL OF PROBABILITY OF DESTRUCTION DURING FATIGUE TESTS M. N. Stepnov p 35–40 refs (See N67-23525 12-17)
5. FOR THE DETERMINATION OF PROBABILITY OF FATIGUE BREAKDOWN DURING RANDOM STATIONARY LOADING A. S. Isayev p 41–51 refs (See N67-23526 12-32)
6. EXPERIMENTAL INVESTIGATION OF FATIGUE FOR RANDOM LOADING A. S. Isayev p 53–68 refs (See N67-23527 12-32)
7. STRESS CONCENTRATION AND CREEP FLOW IN PLATES OF ALUMINUM ALLOYS S. V. Serensen and N. A. Borodin p 69–79 refs (See N67-23528 12-32)
8. RESISTANCE OF ALLOY CHROMIUM–NICKEL–VANADIUM STEEL IN THE ELASTIC–PLASTIC RANGE TO REPEATED LOADS M. N. Stepnov, Ye. V. Glatsintov, and V. P. Kogayev p 81–95 refs (See N67-23529 12-17)
9. BRITTLE STRENGTH OF ALLOY STEEL S. V. Serensen, M. N. Stepnov, V. P. Kogayev, and Ye. V. Glatsintov p 97–117 refs (See N67-23530 12-17)
10. REGULARITY OF CRACK DEVELOPMENT AND FRACTURE OF HULL STEEL WITH CYCLIC LOADING S. V. Serensen and N. A. Makhutov p 119–133 refs (See N67-23531 12-32)
11. INFLUENCE OF LOADING CONDITIONS ON FAILURE OF LOW-ALLOY HULL STEEL N. A. Makhutov p 135–148 (See N67-23532 12-32)

N67-23522 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FATIGUE LIMIT OF ALLOY AVT AND SCALE FACTOR
V. P. Kogayev, Ye. V. Glatsintov, and M. N. Stepnov *In its* Structural Strength of Light Alloys and Steels 13 May 1966 p 3–15 refs (See N67-23521 12-17)

To study the effect of absolute cross section dimensions of samples on the fatigue strength of aluminum alloy AVT, while allowing for scattering, fatigue tests were conducted during bending with rotation on samples with diameters of 40 and 8 mm. The basic relations derived from the statistical theory of strength are shown to sufficiently describe the influence of the scale factor and concentration of stresses on the alloy's fatigue strength while taking into account the scattering of endurance characteristics. Parametric values of the distribution function of fatigue limits m, u, and σ_0, which were found for alloy AVT, permit the fatigue limit of a natural part to be calculated, depending on the probability of destruction. Consequently, they can be used in calculations on fatigue which are based on probability concepts. R.N.A.

N67-23523 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LINEAR REGRESSIONAL ANALYSIS OF RESULTS OF FATIGUE TESTS
M. N. Stepnov *In its* Structural Strength of Light Alloys and Steels 13 May 1966 p 17–23 refs (See N67-23521 12-17)

Based on the treatment of numerous fatigue test results, an indirect method was obtained for determining the sensitivity threshold for structural aluminum alloys. A statistical method based on linear regression analysis is used to treat fatigue test results which takes into account the sensitivity threshold according to cycles. As an example, treatment is given to the test results of smooth aluminum alloy samples with diameters of 8 mm. The tests were conducted at a pure bend of revolving samples on a fatigue machine at four levels of stress. Test results are tabulated along with values of sensitivity threshold according to cycles and statistical characteristics of scattered life values. The calculation of the parameter dispersion of the regression equation line and the parameter confidence intervals is given. The resulting equation of the line of regression $Y=18.6833-9.4270\,x$, and graphs expressing the dependency of dispersion of magnitude log $(N-N_0)$ on the level of stress and the sensitivity threshold from mean value $y=\log(N-N_0)$, are used to construct fatigue curves for different probabilities of destruction for the alloy samples. R.N.A.

N67-23524 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

FATIGUE STRENGTH OF ALUMINUM ALLOYS DURING ASYMMETRIC CYCLE

N. A. Borodin, Ye. V. Giatsintov, V. P. Kogayev, and M. N. Stepnov *In its* Structural Strength of Light Alloys and Steels 13 May 1966 p 25–33 refs (See N67-23521 12-17)

Aluminum alloys are very sensitive to the asymmetry of the cycle of stresses. During testing on the base $N=10^7$ cycles, coefficients of $\psi=0.25$–0.4. For a number of aluminum alloys, the sharp drop of limiting amplitudes of stresses corresponds to the low values of average stresses and ψ appears to be inconstant. For a rough estimate of limiting amplitudes during the asymmetric cycle, at which the average stress of cycle σ_m changes within 0 to 0.3 from the ultimate strength σ_B, it is possible to use dependence $\sigma_2=\sigma_{-1}(-\sigma_m/\sigma_B)$. With an increase of life, coefficient ψ decreases. Thus, with an increase of the base of tests from 10^4 to 10^7 cycles, coefficient ψ decreases on the average by 2 times. During the asymmetric cycle, as during symmetric, scattering of life is increased with the decrease of the amplitude of stresses and the increase of life. At equal absolute values of stress amplitudes, scattering of life during the asymmetric cycle is less than during symmetric. With an increase of amplitude of stresses, the difference in magnitudes of average square deflection decreases. With equal average service lives, the scattering of life for asymmetric and symmetric cycles is practically equal in the region of low average service lives. For large average service lives, scattering for the symmetric cycle is somewhat lower than for asymmetric, although confidence intervals are covered. Author

N67-23525 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ABOUT THE APPRAISAL OF PROBABILITY OF DESTRUCTION DURING FATIGUE TESTS

M. N. Stepnov *In its* Structural Strength of Light Alloys and Steels 13 May 1966 p 35–40 refs (See N67-23521 12-17)

Proposed criterion of the accuracy of appraisals of the probability of destruction for normal distribution of properties during fatigue tests is shown to give a smaller systematic error than the Weibull formula. Considered criterion of accuracy and the appraisal of the probability of destruction may also be used for other forms of tests (static, prolonged static, and others). Author

N67-23529 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

RESISTANCE OF ALLOY CHROMIUM-NICKEL-VANADIUM STEEL IN THE ELASTIC-PLASTIC RANGE TO REPEATED LOADS

M. N. Stepnov, Ye. V. Giatsintov, and V. P. Kogayev *In its* Structural Strength of Light Alloys and Steels 13 May 1966 p 81–95 refs (See N67-23521 12-17)

Results are presented of repeated tensile and bend tests conducted on a chromium-nickel-vanadium martensitic steel during a pulsating change cycle of loads and deformations. Rupture was observed from three forms of tests: at repeated tension of flat samples, at the pulsating cycle of load change, and at repeated tension-compression of cylindrical samples by the pulsating cycle of deformations. The basic cause of destruction at a low number of cycles during tensile tests is the accumulation of plastic deformations, which leads to a stress increase up to the destructive value corresponding to single tension. During the repeated bending test, the accumulation of plastic deformations does not cause a noticeable increase of stress, and consequently, does not lead to static destruction. R.N.A.

N67-23530 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

BRITTLE STRENGTH OF ALLOY STEEL

S. V. Serensen, M. N. Stepnov, V. P. Kogayev, and Ye. V. Giatsintov *In its* Structural Strength of Light Alloys and Steels 13 May 1966 p 97–117 refs (See N67-23521 12-17)

Failure during static tension of smooth and notched samples at +40° to −110°C carries a ductile character. At −196°C, failure comes from abruption. Resistance to abruption which was determined on smooth steel samples with a 6 mm diameter, is equal to 146–148 kg/mm^2. With a lowering of temperature from +40° to −196°C, the resistance to plastic deformation increases 1.6–1.8 times; resistance to failure is increased 7%; total reduction of area (%) of a section of smooth samples is lowered by 3 times. Results of impact bending tests confirmed the possibility of evaluating the critical temperature of brittleness by deformation criterion. A noticeable drop of maximum load during static bending of samples because of lowering test temperatures from +40° to −60°C is not observed. Lowering the temperature to −196°C led to some drop of maximum load. The high value of breaking load and noticeable plastic deformation in the area of the notch attest to stress redistribution in this zone at very low temperatures. Residual stresses in samples with hard-facing lead to lowering of the maximum load by 10–15%, but did not affect the critical temperature of brittleness. With an increase of dimensions there occurs some lowering of limiting rated stresses. Author

N67-23587# General Dynamics Corp., San Diego, Calif. General Atomic Div.

EXPOSURE OF HTGR CANDIDATE CORE PLATE AND THERMAL INSULATION MATERIALS TO IMPURE HELIUM AT 1650°F TO 1850°F FOR 3000 HOURS

J. W. Wunderlich and N. E. Baker 29 Dec. 1966 33 p refs
(Contract AT(04-3)-633)
(GAMD-7377) CFSTI: HC$3.00/MF$0.65

The following materials were exposed in He containing 3000 ppm CO and H_2 at 1650 and 1850°F: Rene 41, Inconel X, Hastelloy X, 304 stainless steel, 430 stainless steel, and Incoloy 800. Changes in mechanical properties and microstructures were evaluated after 500 and 1500 hr exposure of the above materials, and after 3000 hr for 430 stainless steel and Hastelloy X. The results show that 430 stainless steel is the best choice as metallic thermal insulation material in an HTGR, although Hastelloy X is least affected by the environment. NSA

N67-23588# Bendix Corp., Kansas City, Mo.

COMPARATIVE DUCTILITY OF BRITTLE METALS BY A PRECISION ELONGATION TECHNIQUE

Edward P. Patterson 1 Dec. 1966 17 p refs
(Contract AT(29-1)-613)
(BDX-613-92) CFSTI: HC$3.00/MF$0.65

A method of measuring elongation was developed, by which the accuracy of measurement can be increased by one or more orders of magnitude. The method utilizes taperless specimens and measurements of diameters at several distances from the fracture fact. Its method is particularly useful in the evaluation of brittle metals, where determination of elongation by this method is simplified, and where accuracy of results is most important. Author (NSA)

N67-23590# Societa Richerche Impianti Nucleari, Saluggia (Italy).
INFLUENCE OF NITROGEN IN IRON AND STEEL UNDER FAST NEUTRON IRRADIATION Quarterly Report, 1 Jan.–31 Mar. 1966
Sep. 1966 9 p refs
(Contract EURATOM-075–65-10 TEEI(RD))
(EURAEC-1727; QR-2) CFSTI: HC $3.00/MF $0.65

The effects of fast neutrons on mechanical properties of Fe–Ti and Fe–N–Al alloys, before and after isothermal annealing, were investigated. Heat treatment at 300°C was prolonged up to 300 hr in order to study possible secondary embrittlement. Tensile tests were made on Fe–Ti specimens irradiated at 0.7 and 2×10^{18} n cm^{-2}. NSA

N67-23594# Brookhaven National Lab., Upton, N. Y.
CORROSION BY THE ALKALI METALS
J. R. Weeks, C. J. Klamut, and D. H. Gurinsky [1966] 13 p refs Presented at the IAEA Symp. on Alkali Metal Coolants, Corrosion Studies, and System Operating Experience, Vienna
(Contract AT(30-2)-GEN-16)
(BNL-10800; CONF-661110-7) CFSTI: HC $3.00/MF $0.65

A review is presented of the state of the art of corrosion testing of materials by the alkali metals, the models proposed to explain the observed corrosion results, and the status of materials selection for application in alkali metal-cooled systems. Studies and the liquid metal-cooled reactors in operation demonstrate that stainless steels can be considered for structural and cladding applications below 650°C. Corrosion models are reviewed and their inability to explain all the experimental observations discussed. An alternate model is proposed which qualitatively is in agreement with experimental observations. In this model, the rate controlling step is either the surface reaction of Fe with "available oxygen" (dissolved Na_2O) to form an Fe–O–Na complex or the rate at which "available oxygen" can reach the surface to form the complex; which process is rate controlling depends on the temperature, Na velocity, and oxygen concentration in the Na. The solution chemistry of O_2, C, and alkali metal-oxygen-transition metal complexes dissolved in the alkali metals is reviewed. "Molecular" complexes appear unlikely to exist in solution in the alkali metals, although the thermodynamic tendencies for them to form suggest that stable bonds exist in solution between O_2, the transition, and the alkali metals. The insolubility of C in "oxygen-free" Na indicates that C transfer may be associated with O_2 in Na down to very low oxygen levels, although experimental data do not generally confirm this postulate. Corrosion of refractory metals by boiling alkali metals at temperatures above 1000°C is markedly affected by impurities in either the liquid or refractory metal; the addition of Ti, Zr, or Hf as "getters" to the refractory alloys and proper heat treatment to react the "getter" addition with O_2, N_2, C, and H_2 in the alloys are required to prevent their corrosion by the alkali metals at these temperatures. Author (NSA)

N67-23595# Ohio State Univ. Research Foundation, Columbus.
POLARIZATION CHARACTERISTICS OF HIGH PURITY NICKEL-HIGH IRON-CHROMIUM-NICKEL ALLOYS IN SULFURIC ACID SOLUTIONS
D. O. Condit and R. W. Staehle Sep. 1966 63 p refs
(Contract AT(11-1)-1319)
(COO-1319-46) CFSTI: HC $3.00/MF $0.65

Potentiokinetic experiments were conducted to determine the anodic and cathodic polarization behavior of high-Ni ternary Fe–Cr–Ni alloys. All data were obtained ≈1N H_2SO_4 at 25°C. Cr additives tended to shift the entire anodic curve in the active (negative) direction. Ni tends to shift the anodic curve in the noble (positive) direction. A general plateau region was observed for corrosion potential values as composition tends toward pure Ni. Author (NSA)

N67-23602# Battelle Memorial Inst., Columbus, Ohio.
PROPERTY CHARACTERIZATION OF A DUCTILE, TUNGSTEN-BASE SHEET ALLOY Final Report, 8 Feb.–1 Nov. 1966
D. J. Maykuth, K. R. Grube, D. Hauser, and E. S. Bartlett 7 Nov. 1966 39 p refs
(Contract NOw-66-0319-c)
(AD-645143) CFSTI: HC $3.00/MF $0.65

A supply of W-5Re-2.2ThO2 (weight percent) alloy sheet was prepared using procedures developed under a previous contract. This material was evaluated for recrystallization behavior, bend-transition temperature, tensile and stress rupture strengths at temperatures to 1928 C as well as for weldability by electron-beam and gas-tungsten-arc welding. TAB

N67-23628# Army Materials Research Agency, Watertown, Mass.
INVESTIGATION OF SOLIDIFICATION OF HIGH-STRENGTH STEEL CASTING Interim Report, Oct. 1, 1964–Sep. 30, 1965
D. R. Poirier and M. C. Flemings 30 Sep. 1965 122 p refs
(Contract DA-19-020-AMC-5443(X))
(AMRA-CR-63-04/4; AD-645346) CFSTI: HC $3.00/MF $0.65

An analytical and experimental study has been made of microsegregation in dendritic solidification of ternary iron-carbon-chromium alloys. The most realistic model considered assumes uniform concentrations of carbon and chromium in the interdendritic liquid, equilibrium at the solid liquid interface, no diffusion of chromium in the solid, and a uniform concentration of carbon in the solid. Fundamental to the study of solute redistribution during solidification is detailed knowledge of the solid-liquid equilibria. For this reason the determination of the austenite-liquidus of the iron-carbon-chromium system was made which included evaluating the activity of iron, carbon, and chromium in the liquid iron and austenite as functions of temperature and composition. Author (TAB)

N67-23630# Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy.
GROWTH OF COMPOSITES FROM THE MELT
F. R. Mollard and M. C. Flemings Nov. 1966 123 p refs
(Contract Nonr-3963(09))
(TR-2; AD-645345) CFSTI: HC $3.00/MF $0.65

Conditions necessary for plane front growth of two-phase solids from a single phase melt are discussed. The general case is considered where, at equilibrium, the alloy solidifies over a range of temperatures; i.e., it is not of eutectic composition. It is concluded that: (1) plane front solidification is favored by low growth rate, steep thermal gradient, and essential absence of convection; and (2) for steady state solidification, the structure should resemble that of directionally solidified eutectics (lamellar, rod-like). Factors affecting solute redistribution along the growth direction are described quantitatively, by numerical solutions to the diffusion equation. Effects of variations in growth rate on average composition of the solidifying composite are significant. For alloys not too close to a single phase region, the initial transient at constant growth velocity is the order of D/R where D is diffusion coefficient in the liquid and R is interface velocity. Two-phase lead-tin alloys, ranging in composition from 12 atomic per cent to 26 atomic per cent lead, were unidirectionally solidified in a convection-free system, with thermal gradients in the liquid of up to 480C/cm. Plane front solidification was achieved in all alloys at sufficiently steep gradient and slow growth rate. Author (TAB)

N67-23678# IIT Research Inst., Chicago, Ill. Dept. of Metallurgical Engineering.
SOME EXPERIMENTS ON THE RELATIVE HARDNESS OF GRAINS AND GRAIN BOUNDARIES IN THE PRESENCE OF SOLUTES
Mark Goldberg and Paul Gordon Nov. 1966 17 p refs
(Grant DA-ARO(D)-31-124-0597)
(TR-2; AROD-5030-2; AD-645737) CFSTI: HC $3.00/MF $0.65

An alloy of zone refined aluminum plus 0.0124 atomic percent copper has been used to test the possibility that the broad bands of grain boundary hardening due to solute segregation found by Westbrook and Aust (1963) in their tin-silver-, and gold doped zone-refined lead represent a general phenomenon. The results revealed no hardening effect at the boundaries of the copper-doped aluminum. In view of the fact that these results are in striking contrast to those found by Westbrook and Aust, many of the experimental techniques used and the results themselves are described in greater detail than might otherwise be warranted for negative results. Author (TAB)

N67-23681# Societa Ricerche Impianti Nucleari, Saluggia (Italy). Centro Richerche Nucleari.
INFLUENCE OF NITROGEN IN IRON AND STEEL UNDER FAST NEUTRON IRRADIATION Quarterly Report, 1 Oct.–31 Dec. 1965
Sep. 1966 10 p refs
(Contract EURATOM-075-65-10-TEEI RD)
(EURAEC-1726) CFSTI: HC $3.00/MF $0.65

The influence of N_2 on neutron-irradiated Fe and steels was studied. Irradiation was performed and a better design for the irradiation container was studied to avoid undesired temperature increases. Specimens have been prepared from ASTM A 212 B steel melts suitably prepared with different killing elements. Study of the neutron spectrum influence on the radioinduced changes in mechanical and magnetic properties was begun. The possibility of using magnetic property changes of iron alloys as a detector of radiation damage was examined. Author (NSA)

N67-23683# United Kingdom Atomic Energy Authority, Harwell (England). Information Branch.
SYSTEMATICS OF LIQUID METALS AND ALLOYS. VII: THE PRESENT POSITION OF SYSTEMATIC TREATMENT OF LIQUID ALLOYS
F. Sauerwald, P. Brand, and W. Menz 1966 15 p refs Transl. into ENGLISH from Z. Metallk. (Stuttgart), v. 57, 1966 p 103–108
(AERE-TRANS-1060) CFSTI: HC $3.00/MF $0.65

As part of a systematic scheme of the properties of molten binary alloys, the results of new investigations are added and checked to what extent the classification into compound, solution, segregation, and intermediate systems is justified. Of the 789 constitutional diagrams examined with their groups of properties, only 23 did not fit satisfactorily into the present scheme. The conclusions derived from the scheme are discussed. A bibliography of 80 references is included. Author (NSA)

N67-23684# United Kingdom Atomic Energy Authority, Springfields (England). Reactor Fuel Element Lab.
ADDITION OF YTTRIUM TO STAINLESS STEELS
P. D. Parsons 1967 8 p
(TRG-1345) CFSTI: HC $3.00/MF $0.65

The influence of Y on the physical metallurgy of various Fe–Cr and Fe–Ni–Cr alloys is reviewed. The availability and the physical properties of Y are also discussed. The addition of ≈1% Y to 20–20-Nb stainless steel results in a marked improvement in grain stability below ≈1200°C, due to particles of an Y intermetallic phase. Above ≈1200°C, grain growth is significant and the intermetallic phase is redistributed around the grain boundaries. Prolonged heating at high temperatures in air results in oxidation of the Y phase and an apparent embrittlement of the alloy. The main contents of this Report were originally published in the New Scientist, 32: 19(1966). Author (NSA)

N67-23688# Neratoom, N. V., The Hague (Netherlands).
THE STAINLESS STEEL CLADDING OF HEAVY GAGE STEELS Quarterly Progress Report, 1 Apr.–30 Jun. 1966
30 Jun. 1966 10 p Transl. into ENGLISH from French
(Contract EURATOM-008-63-12-TEEB RD)
(QPR-8; EU-2880; EURAEC-1693) CFSTI: HC $3.00/MF $0.65

A satisfactory solution to the problem of stainless steel cladding in a single layer is described. The alloyed flux technique was used. The possibilities of using higher alloyed tapes of grade AISI 309 were also investigated. The results showed that from the deposited metal analysis correction efficiency point of view it is of interest to provide for alloy elements to be added by tape rather than by flux. A skeleton theoretical diagram for interpreting the cladding tests results is included. Author (NSA)

N67-23689# Metallgesellschaft A. G., Frankfurt am Main (West Germany).
FURTHER DEVELOPMENT OF THE $ZrBn_2Sn1$ ZIRCONIUM ALLOY, WITH REFERENCE TO ITS USE FOR CLADDING IN WATER-COOLED REACTORS Final Report No. 2
K. Drefahl, H. Richter, and W. Ruckdechel 23 Jun. 1966 94 p refs Transl. into ENGLISH from German
(Contract EURATOM-019-63-11 TEED)
(EURAEC-1725) CFSTI: HC $3.00/MF $0.65

Work was carried out to improve the properties of the Zr–Nb–Sn alloy by changing its tin content and by adding other alloying elements (Cu, Fe, Cr, Ge, V, Sb, and Te) constituting up to 0.5% of total weight. Corrosion behavior in steam at 400 and 450°C, together with mechanical properties at 450°C, was given special prominence in the investigations. A start was made by investigating the corrosion behavior of 51 alloys. Eleven Zr–Nb alloys to which other elements were added were selected for more detailed investigation. Results showed that the corrosion behavior of the Zr–Nb–Sn alloy in steam heated to 400°C can only be improved to a relatively small extent by changing its composition. A reduction in Sn content induced a considerable improvement in corrosion properties in steam heated to 450°C. In particular, the addition of Cu, Fe, Cr, or Sb was helpful at these high corrosion temperatures. The percentage of H_2 absorption of ternary Zr–Nb alloys with Fe, Cr, or Sb was found to be particularly low. Unfortunately, a reduction in tin content reduces strength and has an adverse effect on creep behavior. The influence of other additional alloying elements is difficult to ascertain, since the Nb content of the various alloys is varied to give roughly the same absorption cross section for thermal neutrons. However, it appears that Sb and V additives give higher short-time strengths than Cu, Fe, and Cr additives. Sb and V also have a good effect on creep behavior. The alloys with 1% Sn (by weight) and Fe additives, which show up particularly well in creep tests, failed at high corrosion temperatures. The Zr–Nb–Sb alloy had relatively high elongation values even after corrosion, while alloys containing Fe showed a sharp elongation value drop in steam at 450°C if they had a Sn content of as little as 0.3%. An increase in Sn content intensifies corrosion and reduces elongation still further. Author (NSA)

N67-23791# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF CYCLIC PLASTIC STRAINS ON METAL FATIGUE IN HOMOGENEOUS AND INHOMOGENEOUS STATE OF STRESS
G. S. Pisarenko, V. T. Troshchenko, and V. I. Bugay *In its* Appl. Mech. 24 Aug. 1966 p 1–15 refs (See N67-23790 12-32)

Results are presented which characterize the behavior of plastic strains in a series of steels and copper in the course of

repeated alternating loading under conditions of a homogeneous (tension–compression), and inhomogeneous (bending) state of stress. It is shown that the proportional limit of cyclic deforming of metals correlates satisfactorily with the fatigue limit. It was established that one and the same plastic strain per cycle in the maximally stressed layers of the material is associated with the same durability of specimens subjected to tests under conditions of a homogeneous and inhomogeneous state. Author

N67-23955# Bureau of Mines, Albany, Oreg.
THORIUM ALLOY SYSTEMS
Hal J. Kelly and Stephen A. O'Hare *In its* Met. Progr. Rept. 30 Jun. 1966 p 13–16 ref (See N67-23953 12-15)

The alloys were studied in two groups, based on the thoria particle size. The first group of alloys was composed of submicron-size thoria additions and was evaluated for possible high-temperature strengthening; the composition range of these alloys was from 1 to 5 weight-percent thoria. The second group consisted of thorium with micron-size thoria particles. These alloys had a composition range from 15 to 50 volume-percent thoria and were used to simulate reactor fuel. The effect of thoria addition and temperature was noted on tensile properties from 400°C to 800°C, hot hardness from 20°C to 850°C, and electric resistivity at ambient temperature. While temperature affected both hardness and tensile strength, the thoria content did not; thoria did affect the electric resistance. Also conducted was a study of cermets containing 15 to 50 volume-percent thoria in a thorium matrix during which tensile properties and electric resistance were measured at room temperature and corrosion resistance at 150°C. K.W.

N67-23957# Bureau of Mines, Albany, Oreg.
INVESTIGATION OF THE SYSTEM UC–UN–UO
Hal J. Kelly, Jack L. Henry, Danton L. Paulson, and Robert Blickensderfer *In its* Met. Progr. Rept. 30 Jun. 1966 p 19–24 ref (See N67-23953 12-15)

Techniques were developed for the production and evaluation of uranium oxycarbide and uranium oxycarbonitride specimens by powder techniques. These techniques have been refined to the point where compositions are trustworthy, and specimen density and quality are satisfactory for physical evaluation. The phase relations in the monocarbide region of the ternary system U–C–O at 1700°C were evaluated and a study was completed of the relationship between composition and both lattice parameters and decomposition pressure of the uranium oxycarbide solid solutions. Developed were techniques for the preparation of high-density specimens of uranium oxycarbide for the evaluation of hot-hardness and thermal conductivity. Results from hot-pressing were not up to expectations, but densities above 90% of theoretical were achieved by the sintering of compacts of finely milled powders. Author

N67-23972 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SCIENTIFIC BULLETIN OF THE CLUG POLYTECHNIC INSTITUTE
20 Sep. 1966 42 p refs Transl. into ENGLISH from Bul.–Stiint. Inst. Politeh. Cluj, n. 7, 1964 p 169–180, 213–221, 231–236 (FTD-TT-65-835; AD-645855) CFSTI: HC$3.00/MF$0.65

CONTENTS:

1. THE IMPORTANCE OF METALLIC MOLYBDENUM AND OF VARIOUS MOLYBDENUM-BASED PRODUCTS IN MODERN TECHNOLOGY A. Domsa p 1–19 refs (See N67-23973 12-17)

2. PRESSING AND SINTERING PROPERTIES OF I.C.P. TYPE MOLYBDENUM POWDERS A. Domsa, A. Palfalvi, M. Filipescu, V. Nicolae, and L. Botha p 20–28 refs (See N67-23974 12-17)

3. DIFFUSION OF MOLYBDENUM FROM THE POWDER STATE ON METALLIC SURFACES M. Filipescu p 29–34 refs (See N67-23975 12-17)

N67-23973 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE IMPORTANCE OF METALLIC MOLYBDENUM AND OF VARIOUS MOLYBDENUM-BASED PRODUCTS IN MODERN TECHNOLOGY
A. Domsa *In its* Sci. Bull. of The Clug Polytech. Inst. 20 Sep. 1966 p 1–19 refs (See N67-23972 12-17)

The properties of molybdenum and molybdenum alloys are discussed. A process for preparing molybdenum trioxide concentrate was developed. A table listing the heat resistant and refractory properties of molybdenum compounds is given. The resistance to rupture of molybdenum and its alloys at elevated temperatures is graphically compared with other materials. Data showing the effect of several alloying elements on the heat resistance of molybdenum after soaking for 100 hrs. are given. The beneficial effect of small amounts of alloying elements, and the unfavorable effect of recrystallization, are noted. Hardness data of molybdenum alloys containing 3% of one of the elements Ta, Ti, Nb, and Cr are compared with pure molybdenum in plots against the temperature up to 1600°C. Other plotted data presented depict hardness changes in various alloys; stresses corresponding to residual deformations; stress/density ratios of various pure metals; the mechanical, thermal, and electric properties of metallic molybdenum; tensile strengths of molybdenum wire; thermal conductivity of molybdenum as a function of temperature, electrical resistivity; and densification of molybdenum powder. L.S.

N67-23974 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PRESSING AND SINTERING PROPERTIES OF I.C.P. TYPE MOLYBDENUM POWDERS
A. Domsa, A. Palfalvi, Mihaela Filipescu, V. Nicolae, and L. Botha *In its* Sci. Bull. of the Clug Polytech. Inst. 20 Sep. 1966 p 20–28 refs (See N67-23972 12-17)

The behavior of molybdenum during its processing from the pressing and sintering of native raw molybdenum powders, is discussed. The characteristics of the powder are presented in a table, and indicate that the powder possesses a favorable granulometric repartition and a satisfactory chemical purity. Graphic data presented and discussed include: 1) densities of molybdenum at various stages of pressing, 2) changes of the filling factor as a function of the force used for pressing, 3) changes in the bending strength of pressed specimens, 4) weight losses in the determination of the notch strength of pressed specimens, 5) variation of the shrinkage during presintering as a function of the pressing force, 6) changes in the bending strength after presintering as a function of the pressing force, 7) influence of the duration of sintering on the density of Mo specimens, and 8) influence of the pressing force on the shrinkage due to sintering. The experiments proved that the Mo powder acquires favorable pressing and sintering properties during the processing treatment, and may be used for powder metallurgical operations. L.S.

N67-23975 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DIFFUSION OF MOLYBDENUM FROM THE POWDER STATE ON METALLIC SURFACES
Mihaela Filipescu *In its* Sci. Bull. of the Clug Polytech. Inst. 20 Sep. 1966 p 29–34 refs (See N67-23972 12-17)

The solid state diffusion of molybdenum onto ferrous alloys was studied; and the best operating conditions resulting in the formation of a coating at approximately the characteristics of molybdenum at temperatures up to 800°C were determined. Room temperature and 800°C sections of the iron and molybdenum rich

portion of the Fe-C-Mo ternary phase diagram indicate the phases in which molybdenum may be present in low carbon steels. A coating was developed based on the α and γ phases. Quality carbon steels with specified composition limits were used as the base materials for the coating tests which were carried out at 900, 1000, and 1100°C. Results indicate that the temperature of 1100°C is most effective on the basis of the diffusion layer thickness. Thickness data as functions of the length of soaking at 1100°C for various time periods, and microstructures of the diffused layers on the carbon steels, are given. It appears that the powder diffusion coating method yields a protective layer for which the thickness can be varied within broad limits. Applications for materials subjected to heating and stresses caused by vibrations erosion due to currents of gas or solid particles circulating at a high rate, are noted. L.S.

N67-24043# Marine Engineering Lab., Annapolis, Md.
Ti-6Al-2Cb-1Ta-0.8Mo TITANIUM ALLOY AS A STRUCTURAL MATERIAL FOR MARINE APPLICATIONS
J. L. Cavallaro Jan. 1967 49 p refs
(MEL-506/66; AD-645937) CFSTI: HC $3.00/MF $0.65

A sea-water, stress-corrosion-resistant compositional variation of Ti-7Al-2Cb-1Ta, Ti-6Al-2Cb-1Ta-0.8Mo, has been developed and evaluated as a candidate pressure-hull material. Thick plate produced from pilot heats and production heats of the alloy were found to have good toughness and to be resistant to sea-water stress corrosion and corrosion fatigue. Properties of weldments of the alloy were found to be as good as the base metal and free from sea-water stress corrosion in the as-welded and stress-relieved conditions. A production heat of Ti-6Al-2Cb-1Ta-0.8Mo was evaluated in tension, compression, Charpy v-notch impact, sea-water stress corrosion, low-cycle fatigue, high-cycle fatigue, Bauschinger effect, and stress relaxation. The alloy has a tensile yield strength of 100 ksi in 1-inch thickness and 96 ksi in 2.5-inch thickness. Preliminary data from processing and heat treatment investigations in progress indicate the strength can be raised approximately 5 ksi. The Ti-6Al-2Cb-1Ta-0.8Mo alloy is considered suitable for use as a weldable, high-toughness structural metal for marine applications. Author (TAB)

N67-24153# Los Alamos Scientific Lab., N. Mex.
NUMERICAL STUDIES OF REGULAR AND MACH REFLECTION OF SHOCKS IN ALUMINUM
Charles L. Mader 17 Jan. 1967 39 p refs
(Contract W-7405-ENG-36)
(LA-3578) CFSTI: HC $3.00/MF $0.65

The regular and Mach reflections of 330 kilobar shocks in aluminum were studied using a high resolution, Lagrangian, two-dimensional, numerical hydrodynamic code of the Magee type. The numerical results compare favorably with the available experimental data. Author (NSA)

N67-24241# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
ADVANCES IN METALLOGRAPHY
Ross J. Jackson and Art E. Calabra, ed. 20 Oct. 1966 225 p refs 12th Metallographic Conf. held in Denver, 18–20 May 1966
(Contract AT(29-1)-1106)
(RFP-658) CFSTI: HC $3.00/MF $0.65

Conference papers are presented pertaining to techniques and applications of electron probe microanalysis, electron microscopy, X-ray diffraction, and optical metallographic methods. For individual titles, see N67-24242 through N67-24265.

N67-24245# National Lead Co. of Ohio, Cincinnati.
A CONTRIBUTION TO THE STUDY OF URANIUM-BASE DILUTE ALUMINUM ALLOYS
W. A. Althaus and M. M. Cook *In* Rocky Flats Div., Dow Chemical Co. Advan. in Metallog. 20 Oct. 1966 p 26–37 refs (See N67-24241 12-17)

The isothermal annealing characteristics of the eutectoidal decomposition of uranium-base dilute aluminum alloys in the beta phase was studied by optical and electron microscopy. The effects of the iron and carbon on this eutectoidal decomposition are described. Author

N67-24260# Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.
PHASE IDENTIFICATION IN SIGMA-BEARING TYPE 304 STAINLESS STEEL
C. M. Owens and E. N. Aqua *In* Rocky Flats Div., Dow Chemical Co. Advan. in Metallog. 20 Oct. 1966 p 146–150 refs (See N67-24241 12-17)

A variety of metallographic techniques are necessary for the positive identification of the phases present in sigma-bearing Type 304 stainless steels. Color staining by selective chemical and electrolytic polishing, is the basic method employed for distinguishing between the ferrite and sigma phases within the austenite matrix. Selected area electron diffraction, transmission electron microscopy, and microhardness determinations have been used to verify these color staining characteristics. Quantitative metallography of the volume fraction of phases present by the point count method is supplemented by magnaguage measurements of the ferrite content. Author

N67-24261# Mound Lab., Miamisburg, Ohio.
THE INVESTIGATION OF PSEUDO-FIVEFOLD SYMMETRY IN CARBONYL PROCESS NICKEL USING TRANSMISSION ELECTRON MICROSCOPY
Gene L. Downs and Japnell D. Braun *In* Rocky Flats Div., Dow Chemical Co. Advan. in Metallog. 20 Oct. 1966 p 151–158 refs (See N67-24241 12-17)
(Contract AT(33-1)-GEN-53)

Electron microscopy and selected area electron diffraction studies of the structure and properties of carbonyl process nickel coatings showed several different types of pseudo-fivefold grains. Photographs illustrating these grains are included to amplify the text. The different types of fivefold symmetry, determined to be possible from angular considerations for the cubic system, are listed as (1) the observed ⟨110⟩ normal to the fivefold with (111) planes for boundaries; (2) the ⟨110⟩ normal to the foil with (110) planes for boundaries with twinned along the (111) planes; (3) the ⟨110⟩ normal to the foil with (112) planes for boundaries; (4) various combinations of these three types; and (5) ⟨112⟩ normal to the fivefold with mixed indices for boundary planes. M.G.J.

N67-24262# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
MICROHARDNESS OF PLUTONIUM-GALLIUM ALLOYS
D. D. Hays *In* Rocky Flats Div., Dow Chemical Co. Advan. in Metallog. 20 Oct. 1966 p 160–167 refs (See N67-24241 12-17)

The effects of surface preparation, indenting load, and gallium content on the microhardness of fully homogenized Pu-0.78, 0.99 and 1.27 wt.% Ga alloys were determined. Descriptive details are given on the standardization of microhardness testing variables for the equipment, the calculation of the logarithmic index, and microhardness values as a function of load for the alloys. These data are used as a basis for evaluating the influence of grain size, specific impurities, cold work internal stresses, and orientation on the microhardness of Pu–Ga alloys.

N67-24263# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
MEASURING PERCENT ALPHA IN DELTA STABILIZED PLUTONIUM ALLOYS BY X-RAY TECHNIQUES

R. J. Jackson, R. J. Pinkney, and R. R. McDonald *In its* Advan. in Metallog. 20 Oct. 1966 p 168–175 refs (See N67-24241 12-17)
(Contract AT(29-1)-1106)

A reliable nondestructive X-ray method is described, in which a diffractometer is used for quantitatively determining the percent alpha in delta stabilized plutonium alloys. Author

N67-24264# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
A BRIGHT FIELD GRAIN STRUCTURE ETCH FOR DELTA PHASE STABILIZED PLUTONIUM
D. D. Hays *In* Rocky Flats Div., Dow Chemical Co. Advan. in Metallog. 20 Oct. 1966 p 176–184 refs (See N67-24241 12-17)

An oxide-free surface delineating grain boundaries was produced in delta phase, stabilized plutonium alloys having a variety of metallurgical treatments. Zirconium stabilized alloys were etched with solutions based on orthophosphoric, tetraphosphoric, or citric acid. Delta phase plutonium stabilized with aluminum or gallium could only be etched with 200 ml ethanol, 116 g citric acid and 10 ml of a solution of either potassium or sodium nitrate in 100 ml of water. Author

N67-24265# Argonne National Lab., Ill. Metallurgy Div.
METALLOGRAPHIC AND X-RAY STUDIES OF ALPHA PLUTONIUM
R. J. Friddle, R. G. Liptai, L. T. Lloyd, and M. D. Odie *In* Rocky Flats Div., Dow Chemical Co. Advan. in Metallog. 20 Oct. 1966 p 185–194 refs Sponsored by AEC (See N67-24241 12-17)

The back-reflection Laue technique was used to evaluate qualitatively the degree of strain in large grains of alpha plutonium produced by high pressure and temperature treatments. It was demonstrated that some grains are strained and have subgrains. In other cases strain-free conditions exist, i.e. the individual diffraction spots are free of asterism and subspots. The Laue photograms and corresponding stereographic projections are given for three basic orientations (010), (100) and (001). The use of the (010) standard projection of plane poles in conjunction with the stereographic projections enables determinations of crystallographic orientations by visual observations alone. Author

N67-24310 Furukawa Electric Co., Ltd., Tokyo (Japan). Central Research Lab.
STUDIES ON WORKABILITY, HEAT TREATMENT CHARACTERISTICS AND CORROSION RESISTANCE FOR PRESSURIZED WATER OF Zr-1% Mo-1% Cr AND Zr-1% Mo-1% Ni ALLOYS
Shigeo Aoki Tokyo, Japan Atomic Energy Res. Inst., Jan. 1966 16 p refs Transl. into ENGLISH from J. Japan Inst. Metals (Sendai), v. 28, no. 1, Feb. 1964 p 22–27 revised
(NSJ-TR-24; Rev.) CFSTI: $3.00

The workability, effect of the heat treatment on the mechanical properties and the micro-structures, and corrosion resistance for pressurized water of Zr–1%Mo–1%Cr and Zr–1%Mo–1%Ni alloys which resulted from previous works have been investigated in comparison with Zircaloy-2. The results obtained are summarized as follows. (1) The percent reductions of the alloys drop-forged in the temperature range of 600°≈900°C were nearly the same as those of Zircaloy-2. (2) Remarkable hardening occurred in both alloys when they were quenched from β phase; (3) The optimum procedures of the heat treatment to obtain the favourable mechanical properties of Zr–1%Mo–1%Cr and Zr–1%Mo–1%Ni alloys were to temper them at 750°C and 600°C for 100 min respectively, after quenching from 950°C in β phase; and (4) The weight gain of Zr–1% Mo–1% Cr alloy over the corrosion period of 500 hr in pure water at 300°C under pressure of 80 kg/cm^2 was a little higher than that of Zircaloy-2 but much lower than that of Zr–1%Mo–1% Ni alloy. Author

N67-24385# Battelle Memorial Inst., Columbus, Ohio.
FORMATION OF ALKALI IRON SULFATES AND OTHER COMPOUNDS CAUSING CORROSION IN BOILERS AND GAS TURBINES Summary Report, Jul. 1–Dec. 31, 1966
31 Dec. 1966 51 p refs
(Contract NObs-94516)
(SR-1; AD-647777) CFSTI: HC $3.00/MF $0.65

Sulfates, formed by the interaction of SO3, SO2, and O2 in flue gas with alkalies from the fuel and iron oxides are invariably found in corrosion areas. Alkali sulfates, such as Na2SO4, are formed rapidly. Iron sulfates, both FeSO4 and Fe2(SO4)3, can also occur, although the thermodynamics are unfavorable in a low-SO3 atmosphere. Alkali sulfates and iron sulfates can react to form alkali iron trisulfates, for example Na3Fe(SO4)3. These are highly corrosive but their formation also requires more SO3 than is found in bulk flue gas. Recent work has shown that the high SO3 level needed to produce these complex sulfates can be provided by catalysis at surfaces, even though the SO3 is too low in the bulk gas stream. Studies reported here show quantitatively that the SO3 concentration immediately next to an Fe3O3 surface can be many times higher than in the bulk stream of gas, and can be ample to provide the SO3 necessary to form the trisulfates. Author (TAB)

N67-24412# Army Materials Research Agency, Watertown, Mass.
NOTCHED PROPERTIES OF HIGH-STRENGTH ALLOYS AT VARIOUS LOAD RATES AND TEMPERATURES
Armando A. Iannelli and F. J. Rizzitano Jul. 1966 25 p refs
(AMRA-TR-66-13; AD-647884) CFSTI: HC $3.00/MF $0.65

Tests were conducted to determine the notched and unnotched strengths of aluminum alloys 7001-T6 and 7075-T6, titanium alloy 6Al-6V-2Sn, uranium alloy 8Mo-0.5Ti, Rocoloy steels and 18% Ni maraging steel at load durations of 10 milliseconds to 5 minutes, and at temperatures from -320 F to +500 F. At room temperatures, as load duration was increased from 10 milliseconds to 5 minutes, the notched and unnotched tensile strengths of those materials were maintained within 10 percent, except that they increased approximately 30 percent for the notched aluminum alloys, and decreased 30% for the unnotched uranium alloy. The notched strength of Rocoloy steel is less than its unnotched strength over the entire test temperature range. Notched strengths of all the other alloys tested are less than their unnotched strengths in the lower test temperature range but exceed the unnotched strengths in the higher temperature range. Author (TAB)

N67-24488# Naval Applied Science Lab., Brooklyn, N. Y. Material Sciences Div.
BIBLIOGRAPHY AND INDEX OF NAVAL APPLIED SCIENCE LABORATORY TECHNICAL REPORTS ON HIGH STRENGTH STEEL Technical Progress Report, 1959–1966
Frank Ginsberg and Irving L. Stern 14 Feb. 1967 68 p refs
(PR-5; AD-647872) CFSTI: HC $3.00/MF $0.65

A bibliography and subject index was prepared of Naval Applied Science Laboratory technical reports covering pertinent information on 80,000 psi to 210,000 psi yield strength steels, with emphasis on HY-80 and HY-130 weldments. Work in these reports deals with transfer of basic laboratory data to production applications. Primary areas of concern are weldability, welding procedures and materials, static and dynamic mechanical properties (including large scale fatigue), explosion bulge, forming, stress relieving and residual stresses. Author (TAB)

N67-24550*# Los Alamos Scientific Lab., N. Mex.
PREPARATION OF A PLUTONIUM-0.4 w/o THULIUM ALLOY ON A MULTIKILOGRAM SCALE
D. R. Harbur, J. W. Anderson, and W. J. Maraman 21 Dec. 1966 10 p refs
(Contract W-7405-ENG-36)
(LA-3621) CFSTI: HC $3.00/MF $0.65

Alloying and casting procedures developed for producing a homogeneous Pu–0.4 wt % Tm alloy are described. The procedures are also adaptable for preparing most Pu-base alloys. The alloying time necessary to make a homogeneous Pu–0.4 wt% Tm alloy can be lowered from several hours to less than 30 min by using a dash-pot stirring unit. To avoid macrosegregation of Tm in the casting, the alloy is chill cast into a mold at ambient temperature. NSA

N67-24551# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
SIMPLIFIED METALLOGRAPHIC TECHNIQUES FOR URANIUM ALLOYS AND OTHER METALS
Ross J. Jackson, W. L. Johns, and Arthur E. Calabra 20 Jan. 1967 12 p
(Contract AT(29-1)-1106)
(RFP-862) CFSTI: HC $3.00/MF $0.65

A simplified metallographic preparation method was developed and proves suitable for many uranium alloys, as well as for beryllium and stainless steel. Samples used in the study are taken from a cut-off wheel or 600-grit paper and placed in an electrolytic cell. Through the procedures developed, mounting and polishing steps have been eliminated and economics in operations achieved. Author (NSA)

N67-24591 Societe d'Etudes, de Recherches et d'Applications poor l'Industrie, Brussels (Belgium).
INFLUENCE OF SURFACE TREATMENT ON THE CORROSION OF CARBON STEEL AND STAINLESS STEEL IN HIGH TEMPERATURE WATER AND STEAM. SECOND PART: EVALUATION OF CORROSION BY MEASURING HYDROGEN IN REACTION [INFLUENCE DU TRAITEMENT DE SURFACE SUR LA CORROSION D'ACIERS AU CARBONE ET INOXYDABLE DANS L'EAU ET LA VAPEUR A HAUTE TEMPERATURE. DEUXIEME PARTIE: EVALUATION DE LA CORROSION PAR LA MESURE DE L'HYDROGENE DANS LA REACTION]
C. Sonnen and M. Warzee Brussels, EURATOM, Feb. 1967 35 p refs In FRENCH; ENGLISH summary
(Contract EURATOM-089-62-7 RDB)
(EURAEC-1764; EUR-1735.f, Vol. II) CFSTI: HC $3.00/MF $0.65

The method described herein allows the study of the reaction kinetics of metals and alloys of the iron family, in high temperature water and steam under mechanical stress. The possibilities and application limitations of this method are defined on basis of results obtained with a pressure vessel steel and with an austenitic stainless steel (AISI 304L) oxidized in water and steam at temperatures ranging between 300° and 450°C. Curves giving the evolution of total corrosion and of the rate of corrosion confirm the influence of the surface state previously established by tests in autoclaves. The effects of this influence appear from the first moments of the reaction and generally remain in the course of long duration tests. Author

N67-24636*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
PROCEDURES FOR EXTERNALLY LOADING AND CORROSION TESTING STRESS CORROSION SPECIMENS
T. S. Humphries 29 Jun. 1966 37 p refs
(NASA-TM-X-53483) CFSTI: HC $3.00/MF $0.65 CSCL 11F

The procedures for externally loading various types of stress corrosion specimens and a description of the test specimens are presented. An accelerated corrosion test method which consists of alternate immersion in a 3-1/2 percent sodium chloride solution is also described. The types of specimens described and the methods of externally loading and corrosion testing the specimens have been found to be reliable for stress corrosion evaluation of most aluminum alloys, and have shown promise for ferrous and nickel alloys. Author

N67-24637*# Boeing Co., Seattle, Wash. Aerospace Group.
INVESTIGATION OF THE FLAW GROWTH CHARACTERISTICS OF 6Al-4V TITANIUM USED IN APOLLO SPACECRAFT PRESSURE VESSELS
C. F. Tiffany and J. N. Masters Mar. 1967 85 p refs
(Contract NAS9-6665)
(NASA-CR-65586) CFSTI: HC $3.00/MF $0.65 CSCL 11F

Plane-strain cyclic and sustained load flaw growth characteristics were evaluated for 6Al-4V titanium forgings and weldment heat affected zones. Investigations were conducted at temperatures ranging from 65° to 110°F in the environments of Aerozene 50, monomethylhydrazene, nitrogen tetroxide, methanol, Freon MF, and distilled water (with and without sodium chromate additions). Basis for evaluation was the determination of threshold stress intensity values in the various liquid environments. Data generated in this report are presented in a manner which is directly useful in establishing design, inspection, testing, and operational requirements of Apollo, as well as other pressure vessels. Author

N67-24653# Army Materials Research Agency, Watertown, Mass.
EFFECT OF TEMPERATURE AND NOTCH RADIUS ON MECHANICAL PROPERTIES OF TITANIUM ALLOY 6Al-6V-2Sn-4Zr
Armando A. Iannelli Sep. 1966 17 p refs
(AMRA-TR-66-26; AD-647154) CFSTI: HC $3.00/MF $0.65

Tests were conducted to obtain data required for the evaluation of titanium alloy 6Al-6V-2Sn-Zr. Tests were conducted on notched and unnotched tensile specimens at temperatures ranging from −321 F to +437 F. Notch radii were varied from 0.001 inch to 0.100 inch (Kt = 1.8 to 8). The results show that: (1) notch tensile strength may increase up to 275 percent as notch radius increases; (2) there exists an optimum notch radius; and (3) tensile and yield strengths decrease approximately 30 percent as temperature increases from −148 to +437 F. TAB

N67-24658# General Electric Co., Philadelphia, Pa. Missile and Space Div.
DEVELOPMENT OF COMPOSITE STRUCTURAL MATERIALS FOR HIGH TEMPERATURE APPLICATIONS Final Report, 22 Nov. 1965–22 Nov. 1966
Juan Chorne, Charles H. Bruch, and Willard H. Sutton Jan. 1967 121 p refs
(Contract NOw-66-0443-d)
(AD-646919) CFSTI: HC $3.00/MF $0.65

The report gives the development of new structural composite materials having high strength-to-weight ratios at elevated temperatures. The current effort was directed towards the use of nickel and nickel alloys as the matrix to be reinforced by high strength Al2O3 single crystal whiskers. The major emphasis during this contract (22 Nov. 1965 - 22 Nov. 1966) was placed on evaluating factors important to two potential processes for making high strength composites; namely, liquid metal infiltration and high temperature pressure-bonding of electro-formed whisker bundles. In support of these studies, some effort was devoted to whisker growth, whisker evaluation, and to whisker handling studies. Author (TAB)

N67-24756# Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Center.
TWINNING AND THE LOW TEMPERATURE MECHANICAL PROPERTIES OF POLYCRYSTALLINE COLUMBIUM, MOLYBDENUM AND CbMo ALLOYS
B. J. Shaw 31 Jan. 1967 40 p refs
(Contract Nonr-4442(00))
(AD-646682) CFSTI: HC $3.00/MF $0.65

Results of the mechanical tests, in compression, tension, and by stress relaxation, on columbium, neutron-irradiated and non-irradiated molybdenum, and three CbMo alloys are discussed. The tests were made in the range 200C to -269C, which covers the ductile-brittle transition temperature of all the polycrystalline materials used. The results indicate that point defects in the crystal lattice inhibit dislocation multiplication mechanisms, thereby increasing the yield and twinning stresses and enhancing the embrittlement. Etch-pit and electron microscopy studies in columbium are described. A theoretical investigation of slip on the b.c.c. (110) and (112) planes is also given. TAB

N67-24791# Pennsylvania Univ., Philadelphia. Lab. for Research.
THE UNIQUE FEATURE OF A LOW ANGLE BOUNDARY IN THE Cu-Zn SUPERLATTICE
James V. Rinnovatore and Norman Brown Philadelphia, Pa., Frankford Arsenal, 1966 11 p refs Repr. from Phil. Mag., v. 14, no. 129, 1966 p 629–635
(FA-A66-16; AD-647359) CFSTI: HC $3.00/MF $0.65

Unique features of a low angle boundary have been observed in ordered beta-brass. The boundary consists of a dislocation network made up of a<111> superlattice dislocations which have combined to form two a<001> segments. The two a<001> dislocation segments may have three physically distinct configurations of which only one is stable. The stable configuration best fits the experimental observation. The network also contains expanded and contracted nodes whose structure depends upon the presence of extended superlattice dislocations. Author (TAB)

N67-24882# Naval Research Lab., Washington, D. C.
ARPA COUPLING PROGRAM ON CORROSION Quarterly Report
E. P. Dahlberg, ed. Dec. 1966 11 p
(Contracts Nonr-610(09); Nonr-760(31); N00014-66-C0365; ARPA Orders 878; RR-007-08-44-5512)
(NRL-MR-1739; QR-1; AD-645859) CFSTI: HC $3.00/MF $0.65

A progress report of the research investigation being carried out on the problem of stress-corrosion cracking of high strength materials is presented. Work concerning physical metallurgy, surface chemistry, fracture mechanics, and characterization tests and translation related to stress-corrosion cracking is described. The materials being studied include high strength steels, titanium alloys, and aluminum alloys. Author (TAB)

N67-24914# Naval Research Lab., Washington, D. C.
METALLURGICAL CHARACTERISTICS OF HIGH STRENGTH STRUCTURAL MATERIALS Quarterly Report, Apr.-Jun. 1966
P. P. Puzak, K. B. Lloyd, R. W. Huber, R. J. Goode, E. A. Lange et al Aug. 1966 86 p refs
(NRL-6513; AD-646520) CFSTI: HC $3.00/MF $0.65

A progress report covering the research studies in high strength structural metals conducted during the period April through June 1966 is presented. The report includes fracture toughness studies on specially melted 18% Ni grade 250 ksi maraging steel and a Cr-Ni-Mo stainless steel. Welding studies on a 12Ni-5Cr-3Mo maraging steel with 12Ni-3Cr-3Mo filler metal wire are described with the problems associated with developing optimum properties in both plate and weldment being discussed. Results of fracture toughness studies on titanium alloys and aluminum alloys are presented in which engineering type tests and fracture mechanics techniques are employed. The fracture toughness index diagrams for steels and titanium are presented based upon the correlations developed with the engineering test methods. Preliminary fracture toughness correlation diagrams are presented for titanium alloys based upon fracture mechanics test methods. Results of a study on the low cycle fatigue crack propagation of a 9Ni-4Co-0.25C steel in air and salt water is discussed and compared to similar data obtained for other steels covering a spectrum of yield strengths. Stress-corrosion-cracking studies were conducted on titanium alloys, aluminum alloys, and steels. TAB

N67-24917# Battelle Memorial Inst., Columbus, Ohio.
AN INVESTIGATION OF THE EFFECTS OF SOLUTE ELEMENTS ON THE MAGNETOELASTIC DAMPING AND COERCIVITY IN VERY PURE IRON Final Report
R. E. Maringer 1 Feb. 1967 24 p refs
(Contract Nonr-2606(00))
(AD-646513) CFSTI: HC $3.00/MF $0.65

The existence of ferromagnetic domains and domain walls in alpha iron provides the basis for a wide variety of related magnetic and magnetoelastic properties which reflect the behavior of defects in the iron lattice. The special case of solute interstitial atoms serves as a general example. The interstitial atoms tend to order with respect to the magnetic vector within a domain, and thereby tend to inhibit domain-wall motion. Since the domain walls can be induced to move by imposing either a magnetic field or a stress, there is a considerable parallelism between the results of both experimental techniques. For example, magnetic permeability has its counterpart in the strain-amplitude dependence of magnetoelastic damping; the time-dependent decrease in magnetic permeability after demagnetization has its counterpart in the time-dependent decrease in magnetoelastic damping after demagnetization; the temperature dependence of magnetic permeability has its counterpart in the magnetoelastic contribution to the dynamic modulus. The role played by magnetic- and stress-induced ordering in these phenomena is now reasonably well understood. Author (TAB)

N67-24918# Westinghouse Electric Corp., Pittsburgh, Pa. Research Labs.
CRYSTAL MORPHOLOGY AND MECHANISMS OF GROWTH OF ALPHA-Fe_2O_3 WHISKERS ON IRON
Richard L. Tallman and Earl A. Gulbransen 5 Dec. 1966 21 p refs
(Contract Nonr-4949(00))
(TR-1; AD-646646) CFSTI: HC $3.00/MF $0.65

Growths on pure iron at 400 degrees C to 500 degrees C in dry oxygen were studied. Selected area electron diffraction patterns of individual whiskers as well as electron diffraction texture patterns of oxidized surfaces showed the whisker axis to be <-1-120>. The axial rotation indicated by the pattern is that resulting from an axial twist. The axial twist provides evidence that the most simple oxide whiskers have a single axial screw dislocation with a 5.03 A Burgers vector. Arguments are presented for the view that growth of the whisker occurs by diffusion of iron atoms or ions through the dislocation and reaction with oxygen at the tip. Author (TAB)

N67-24925# Naval Research Lab., Washington, D. C.
THE EFFECT OF NITROGEN ON THE TENSILE AND CREEP-RUPTURE PROPERTIES OF NIOBIUM
J. Stoop and P. Shaninian 31 Oct. 1966 24 p refs
(NRL-6484; AD-647889) CFSTI: HC $3.00/MF $0.65

Variations in the mechanical properties of niobium caused by nitrogen additions in amounts to give single-phase and two-phase structures were investigated at both room and high temperatures.

Nitrogen in solid solution raised room-temperature hardness and tensile strength. Increasing the nitrogen content to give two-phase structures however produced no additional strengthening. At elevated temperatures, the effect was different in that, with increase in nitrogen content, there was a continued rise in tensile strength through the two-phase region. Creep-rupture strength of niobium was improved by nitrogen in solution at temperatures slightly below 0.5 times the melting temperature, whereas above this temperature the strength was unaffected. This change in the nitrogen effect with temperature appears to be related to a concurrent change in the mechanism controlling creep. An increase in the nitrogen content of the two-phase alloys produced strengthening throughout the 1700 to 2600F test range. Ductility was high for all alloys at elevated temperatures and, except for a high-nitrogen alloy, also at room temperature. Author (TAB)

N67-24955# Case Inst. of Tech., Cleveland, Ohio. Dept. of Metallurgy.
STRUCTURE AND GROWTH OF WIDMANSTAETTEN FERRITE AND BAINITE
J. M. Oblak and R. F. Hehemann Feb. 1967 57 p refs
(Contract Nonr-1141(15))
(TR-5; AD-647298) CFSTI: HC $3.00/MF $0.65

Transmission microscopy has been used to demonstrate that Widmanstaetten ferrite, upper bainite and lower bainite can be distinguished on the basis of their substructures. Widmanstaetten ferrite forms as single crystals whereas upper and lower bainite develop as aggregates of smaller substructural units. The structural transition between acicular ferrite and upper bainite identifies a structural B sub s temperature which agrees with that determined by kinetic techniques. Correlation of optical and transmission micrographs provides indirect evidence that both upper and lower bainite grow by the repeated nucleation of substructural units which propagate rapidly to a limited size. This leads to the concept that both forms of bainite form initially with substantial supersaturation and the kinetics of carbide precipitation from supersaturated ferrite contributes significantly to the differences between the two forms of bainite. It is proposed that growth rates of bainite measured by hot stage microscopy refer to the rate at which substructural units nucleate rather than to the rate at which a unique interface advances under either diffusion or interface control. Author (TAB)

N67-24967# Pennsylvania Univ., Philadelphia. School of Metallurgical Engineering.
ELECTRON MICROSCOPE OBSERVATIONS OF QUENCHED AND AGED GOLD AND GOLD–PALLADIUM ALLOYS
Roger H. Cook and Robert Maddin 30 Jan. 1967 94 p refs
(Contract Nonr-551(55))
(AD-646455) CFSTI: HC $3.00/MF $0.65

A review of past work on the behavior of vacancies in quenched metals is presented, with emphasis upon gold and transmission electron microscopy data. Results are presented on Au, Au-5 at% Pd, and Au-10 at% Pd foils quenched from 0.875 Tm (Tm = absolute melting temperature) and examined in an electron microscope. It is found that increasing palladium content causes an increase in the number of faulted dislocation loops in the quenched and aged material and in the concentration of vacancies annihilated at such loops. However stacking fault tetrahedra represent the most important sinks in all cases. Some reasons for the increased importance of dislocation loops as vacancy sinks in the alloys are discussed. Changes in stacking fault energy due to alloying are not thought significant in producing this effect. Possible roles of nucleus configurations are discussed and a model is presented in which tetrahedra become less effective as sinks as their growth proceeds, owing to changes in solute concentration near them. However the effectiveness of loops as sinks is not expected to change significantly during ageing with the result that dislocation loops can become the main sinks in the later stages of ageing. TAB

N67-24982# Watervliet Arsenal, N. Y. Benet Labs.
ELECTROFORMING OF THE COMPOSITES OF NICKEL REINFORCED WITH SOME HIGH-STRENGTH FILAMENTS
Iqbal Ahmad, V. Peter Greco, and Joseph M. Barranco Jan. 1967 82 p refs
(WVT-6709; AD-646386) CFSTI: HC $3.00/MF $0.65

Composites of nickel reinforced with up to 35 volume percent (uniaxially aligned) tungsten filament (.0005 inch diameter) and 11 volume percent (randomly distributed) alpha-Al2O3 whiskers, have been prepared by electrodeposition from sulphamate bath. The tensile properties of these composites, after annealing at 650 degrees C in H2 for one-half hour, were found to be a linear function of the volume fraction of the reinforcement. The feasibility of electroforming boron filament-Ni, glass filament-Ni and SiC whiskers-Ni composite has been demonstrated. Effect of these inclusions on the microstructure of electrodeposited nickel before and after annealing, and the nature of fracture of these composites have also been investigated. Author (TAB)

N67-25029*# National Aeronautics and Space Administration, Washington, D. C.
SINTERING OF CERMET PRODUCTS COMPRESSED BY IMPACT LOADS [SPEKANIYE METALLOKERAMICHESKIKH IZDELIY, SPRESSOVANNYKH IMPUL'SNYMI NAGRUZKAMI]
O. V. Roman and Ye. A. Doroshkevich Jan. 1967 6 p refs
Transl. into ENGLISH from Poroshkovaya Met., Akad Nauk UKR. SSR (Kiev), v. 42, no. 6, Jun. 1966 p 6–10
(NASA-TT-F-10660) CFSTI: HC $3.00/MF $0.65 CSCL 11F

Discussion of the physical and mechanical properties of cermet products obtained by sintering powdered iron at temperatures up to 1100°C under dynamic impact compression. Sintered iron compacts produced under impact compression are found to have higher work-hardening properties than products compressed statically. The experimental technique is described. Author

N67-25040*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio.
FIBERING OF OXIDES IN REFACTORY-METAL MATRICES
Robert W. Tech, John W. Weeton, and Robert A. Signorelli Washington, NASA, May 1967 48 p refs
(NASA-TN-D-3923) CFSTI: HC $3.00/MF $0.65 CSCL 11F

Combinations of oxides and refractory metals were investigated in order to determine the conditions under which oxides could be made to elongate during mechanical working to form fibers and thereby provide reinforcement for refractory metals. Metallographic examination was used to classify the microstructure of the composites, and tensile and stress-rupture tests were employed to determine mechanical properties. Composites containing fibered oxides exhibited mechanical properties markedly superior to the additive-free base materials, while composites in which fibering of the oxide did not occur showed little or no improvement in these mechanical properties. The correlation between the length-diameter ratio of the fibered oxides and the elevated-temperature tensile strength of the composites could not be made. Although some indication of a correlation between the length-diameter ratio and the stress-rupture properties was indicated. The actual fibering of the oxides was related to the crystal structure of the oxide, the extrusion temperature, and the extrusion ratio at which reduction was accomplished. Author

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N67-23497# Institute of Modern Languages, Inc., Washington, D. C.
CONSTRUCTION STRENGTH AND DEFORMATION PROPERTIES OF FIBER GLASS REINFORCED PLASTICS
Yuriy Matneyevich Tarnopol'skiy and Al'bert Martynovich Skudra Ft. Belvoir, Va., Army Engr. Res. and Develop. Labs., Dec. 1966 327 p ref Transl. into ENGLISH of the book "Konstruktsionnaya Prochnost i Deformativnast Stecloplasticov" Riga, Izd Zinatne, 1966
(Contract DA-44-009-AMC-1563(T))
(FRDL-T-1875-66; TT-67-60676; AD-645948) CFSTI: HC $3.00/MF $0.65

The factual material cited in this book describes the behaviour of fiber glass - reinforced plastics principally in the case of elongation and, in parts, in the case of bending. Such an approach is not an exhaustive one. However, if we take into consideration the fact that a uniaxial stress is usually selected as an equivalent stress in evaluating the load - bearing capacity of machine parts, and that in the first approximation the time before collapse is determined by the maximum normal stress irrespective of the type of stressed state, the mentioned data may find practical application in calculations of the strength of stressed parts made of fiber glass - reinforced plastics. This work is a survey covering numerous foreign and domestic investigations, as well as the results of investigations conducted in this field at the Institute of Polymer Mechanics, AN Latv. SSR. TAB

N67-23519# Whittaker Corp., San Diego, Calif. Narmco Research and Development Div.
ROLE OF FIBER FINISH IN WET STRENGTH RETENTION OF GLASS FIBERS Final Summary Report, 1 Jun. 1964–1 Jun. 1966
Stanley Freske and William H. Otto Jun. 1966 64 p
(Contract Nonr-4522(00)(X))
(MJO-362; AD-645880) CFSTI: HC $3.00/MF $0.65

An experimental program was conducted to establish the role of the finish in the strength retention of E-glass fibers exposed to humid environments. The first phase was concerned with determining the basic strength of the dry fiber, the effects of moisture on the bare fiber, and the effectiveness of certain methods for removing moisture from the fiber surface. For this purpose, dry fibers were produced under highly controlled environmental conditions, thus obtaining reproducible strength. For comparison, fibers were also produced in a normal, humid atmosphere. This provided a basis for the second phase of the program which involved the evaluation of the effectiveness of a silane-epoxy finish in providing strength retention in the fiber. Author (TAB)

N67-23601# IIT Research Inst., Chicago, Ill.
FRACTURE MECHANISMS IN POLYCRYSTALLINE NONMETALLIC MATERIALS Final Report, 1 Oct. 1965–1 Oct. 1966
N. M. Parikh Watertown, Mass., Army Mater. Res. Agency, Oct. 1966 61 p refs
(Contract DA-19-066-AMC-288(X))
(IITRI-B6057-12; AMRA-CR-66-09(F); AD-645142) CFSTI: HC $3.00/MF $0.65

The objective of this program was to study the mechanism of fracture in Al2O3 and to investigate the role of dislocations in crack nucleation. The grain size dependence of strength was found to have a slope of 1/3, and the results were analyzed in terms of the plastic work term associated with a moving crack. Metallographic work confirms the motion of dislocation within the grains. It also suggests twinning as a mode of deformation. In single crystal alumina, the surface condition and heat treatment have a pronounced influence on strength. Heat treatment of sapphire develops low angle grain boundaries which serve as a source of mobile dislocation. Dislocation velocity-stress measurements were made in the (1120) plane. The stress exponent was found to be 32, which is surprisingly low. The actual stress necessary for moving dislocations is of the order of 90% of the fracture stress. Author (TAB)

N67-23620# Picatinny Arsenal, Dover, N. J. Plastics Technical Evaluation Center.
GLOSSARY OF PLASTICS TERMS: A CONSENSUS
Norman E. Beach Dec. 1966 97 p refs
(PLASTEC-14; AD-645208) CFSTI: HC $3.00/MF $0.65

The report presents a glossary of terms relating to plastics, adhesives and elastomers; materials and techniques. It represents a consensus of opinion from various general or specific glossaries available in the open literature. Terms defined are thus general or esoteric. Definitions which tie in with plastics and the related materials are included only; available dictionary definitions are not used. Author (TAB)

N67-23638# Army Natick Labs., Mass. Clothing and Organic Materials Div.
COMPARATIVE STUDY OF PICKER AND DRAW-FRAME BLENDS OF COTTON AND NYLON
Shyamkant D. Shahane, Virendra Singh (Lowell Technol. Inst.), and Louis I. Weiner Nov. 1966 67 p refs
(TR-67-22-CM; TS-143; AD-645153) CFSTI: HC $3.00/MF $0.65

Blended yarns were produced from a good grade of cotton (1 1/2 inch American-Egyptian) and nylon 420 (1 1/2-inch - 2.3 denier) with percentages of nylon of 0, 25, 50, 75, and 100. Blending was done at the picker and at the drawframe for each blend composition. All yarns were spun to a nominal 28(s) count (cotton system) with a twist-multiplier of 3.0. Cross-sections of these yarns were examined microscopically to determine the longitudinal, radial, and rotational distributions of the fibers. It was observed that the yarns produced by picker blending were more uniform in composition than those produced by draw-frame blending. However, the draw-frame blends conformed more closely to the planned nominal composition of the yarns. The radial distribution analyses indicated that for both the picker and draw-frame blends there was in most instances a deficiency of nylon at the periphery and at the center of the yarns. However, away from the center and periphery the blend composition closely matched the average blend composition of the yarns. The rotational distribution analyses showed that sectors having a high nylon concentration were found to be flanked by sectors of slightly more than average nylon concentration, for the yarns examined. Author (TAB)

N67-23654*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
POLYMER RESEARCH
In its Supporting Res. and Advanced Develop. 28 Feb. 1967 p 177–201 refs (See N67-23641 12-11)

Studies are presented for the determination of network density of filled composites from stress–strain measurements made in the swollen state, the suitability of thermoplastic rubbers as binders for composite solid propellants, the reaction of nitroso compounds with unsaturated hydrocarbons. Other polymer researches investigated are the electron spin resonance study of the reaction of sodium and poly-4-vinylbiphenyl, the photovoltaic effect in the charge transfer of poly-N-vinylcarbazole complexed with iodine, and cryogenic bladder bag materials. M.W.R.

N67-23741# Du Pont de Nemours (E. I.) and Co., Aiken, S. C.
HIGH TEMPERATURE ADSORBENTS FOR IODINE Progress Report, Jan. 1966–Sep. 1966
Robert C. Milham Dec. 1966 75 p refs
(Contract AT(07-2)-1)
(DP-1075) CFSTI: HC $3.00/MF $0.65

A high-temperature coconut-shell carbon (ignition temperature ≈530°C), which was developed by an American manufacturer, was shown in preliminary tests to meet specifications of the Savannah River Plant confinement system for removal of iodine. A procedure was developed to measure ignition temperature, to evaluate promising new types of activated carbon, and to evaluate the effects of variables (such as air flow, bed properties, impregnants, and plant service) on ignition temperature. Results of these evaluations and a literature survey of ignition temperature are reported. Author (NSA)

N67-23876# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
OILS FOR GAS-TURBINE INSTALLATIONS
B. V. Losikov and A. D. Fat'yanov 25 Apr. 1966 16 p ref Transl. into ENGLISH from Khim. i Tekhnol. Topliv i Masel (Moscow), no. 3, 1964 p 58–62
(FTD-TT-65-1843; TT-66-62442; AD-640307)

Conclusions: There has been shown the possibility of considerable improvement in the stability of transformer oil at 170 and 200°C with the additive of ionol (0.2–0.7%). It was established that the addition of 1% of sovol to transformer oil raises its antiwear properties to the level of the antiwear properties of the oil MK-22, while the presence of sovol in the oil does not lessen its antioxidation stability and does not lower its receptability to ionol. Tests of transformer oil which contains ionol and sovol on a fullsized gas-turbine installation confirmed completely the possibility of dependable working on the equipment with the indicated oil. Oil for gas turbines containing additives of ionol and sovol at the present time is being put out in accordance with GOST 10289-62. Author (TAB)

N67-23966* Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
EXPERIMENTAL INVESTIGATION OF ULTRAHIGH VACUUM ADHESION AS RELATED TO THE LUNAR SURFACE Quarterly Progress Report, 1 Jan.–31 Mar. 1967
J. A. Ryan 26 Jun. 1964 67 p refs
(Contract NAS7-307)
(NASA-CR-83647; A-830-BBK3-37; QPR-11) CFSTI: $3.00 CSCL 11B

CONTENTS:

1. EXPERIMENTAL INVESTIGATION OF ULTRAHIGH VACUUM ADHESION AS RELATED TO THE LUNAR SURFACE J. A. Ryan 10 p (See N67-23967 12-18)

2. PRODUCTION OF SURFACE ELECTROSTATIC CHARGING ON DIELECTRICS CLEAVED IN VACUUM: THEORETICAL J. J. Grossman 39 p refs (See N67-23968 12-18)

3. ADHESIONAL BEHAVIOR OF AIR AND ULTRAHIGH VACUUM FORMED SILICATE SURFACES J. A. Ryan and M. B. Baker 23 p refs (See N67-23969 12-18)

N67-23967* Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Div.
EXPERIMENTAL INVESTIGATION OF ULTRAHIGH VACUUM ADHESION AS RELATED TO THE LUNAR SURFACE
In its Experimental Investigation of Ultrahigh Vacuum Adhesion as Related to the Lunar Surface 26 Jun. 1964 10 p (See N67-23966 12-18)

Work consisted of 1) completion of the system modifications and repairs, 2) measuring the adhesion between differing silicate minerals whose contact faces have been formed simultaneously by cleavage at ultrahigh vacuum, and 3) continuation of the theoretical analyses of the observed long-range attractive forces. The system modifications consisted of the design and air testing of a double cleavage device and an electrometer probe, and the installation of additional ports and feed-throughs to permit operation of these, and a residual gas analyzer which is to be included in the system. Eight double cleavage runs were made. Of these one was successful, one, though basically unsuccessful, provided some interesting information, and the remaining six were failures. The successful double cleavage run was for orthoclase (001) and microcline (001). The adhesion force between these was about 0.4 gm initially, and the adhesion gradually dropped below detectable in a few hours. Author

N67-23968* Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
PRODUCTION OF SURFACE ELECTROSTATIC CHARGING ON DIELECTRICS CLEAVED IN VACUUM: THEORETICAL
Jack J. Grossman *In its* Experimental Investigation of Ultrahigh Vacuum Adhesion as Related to the Lunar Surface 26 Jun. 1964 39 p refs Presented at the Adhesion of Mater. in Aerospace Environments Symp., Toronto, 1–2 May 1967 (See N67-23966 12-18)

The formation of considerable surface charging for silicates cleaved at 10^{-10} torr was observed. This charging is stable, apparently non-uniform on a macroscopic scale, persists to 10^{-4} torr, and contributes significantly to the adhesion. Additional observations show that the resultant force field is of such a nature that it can rotate the samples into alignment, and that while on some occasions the samples are attracted to any metal in the vicinity, on other occasions there is no attraction. This paper considers mechanisms which could be responsible for this charging; in particular, the electronic structure of crystalline dislocations and non-uniform impurity distributions which produce charge mosaics. A number of theoretical models are discussed by which an electric polarization can be induced into non-piezoelectric, dielectric crystals. Some brief comments are made concerning the role these surface charging mechanisms may play in the adhesional behavior of lunar materials. Author

N67-23969* Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
ADHESIONAL VACUUM FORMED SILICATE SURFACES
J. A. Ryan and M. B. Baker *In its* Experimental Investigation of Ultrahigh Vacuum Adhesion as Related to the Lunar Surface 26 Jun. 1964 23 p refs Presented at the Adhesion of Mater. in Aerospace Environments Symp., Toronto, 1–2 May 1967 (See N67-23966 12-18)

The possible adhesional behavior of lunar silicates was investigated by determining the forces between air-formed (or contaminated) and vacuum formed (clean) surfaces. For the air-formed surfaces, the adhesion force was generally relatively low, in no case exceeding 5×10^2 dynes. Under low load the adhesion appeared to be due to the action of the dispersion forces, and was generally in the range 10^{-1}–1 dyne. At higher loads the adhesion force increased rapidly and appeared to be due to the action of the normal atomic bonding forces. For the vacuum-formed surfaces, it was found that the adhesion force was much larger, and that a considerable amount of surface electrostatic charging was produced during surface formation. The results indicate that the range of lunar adhesional phenomena can be quite large. L.S.

N67-24032# Royal Aircraft Establishment, Farnborough (England).
SNATCH-TEARING OF FABRICS: COMPARISON OF SIX FABRICS
J. E. Swallow and E. Mikolajewski Sep. 1966 27 p refs
(RAE-TR-66299) CFSTI: HC$3.00/MF$0.65

The snatch-tearing method has been used to compare the response to a tearing agency of six biaxially tensioned fabrics. The sum of the warpwise and weftwise torn lengths has been taken as the criterion of tear. Analysis of variance has been made and response equations determined, characterizing the length of tear

in terms of the significant factors. The dependence of tear length on energy input is closely linked with the breaking strength of the fabric. The relationship for the six fabrics is very close to the hyperbolic form. Author (ESRO)

N67-24257# Oak Ridge National Lab., Tenn.
AN EFFECT OF CURING STRESSES IN EPOXY RESINS
R. S. Crouse and R. J. Gray *In* Rocky Flats Div. Dow Chemical Co. Advan. in Metallog. 20 Oct. 1966 p 118–123 ref
Sponsored by AEC (See N67-24241 12-17)

Metallographic examination of some brazed T joints revealed cracking when other mechanical tests indicated a sound joint. The size and location of the cracks pointed to a failure occurring during curing of the specimen mount. Several mounting procedures were tried to confirm this suspicion, and finally a sound joint was retained using epoxy resin and pelletized alumina. The addition of pelletized alumina to the epoxy resin prevented cracking by absorbing some of the curing stresses. Nickel plating also eliminates cracking but introduces other difficulties when etching. Author

N67-24400*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LONG-LIVED RADIOACTIVITY PRODUCED IN NORTHERN OHIO CONCRETE MATERIALS BY NEUTRON ACTIVATION
Ira T. Myers and James A. Kish Washington, NASA, May 1967 12 p refs
(NASA-TM-X-1361) CFSTI: HC$3.00/MF$0.65 CSCL 11B

Measurements were made of trace element concentrations of concrete materials (cement, sand, and gravel) to be used in the NASA Plum Brook Space Propulsion Facility near Sandusky, Ohio. The purpose of the measurements was to select material that would minimize neutron activation of the completed facility during a nuclear test. Exposure rates resulting from best- and worst-case material selection are considered as a function of decay time after a nuclear test has been completed. The major activities found after neutron irradiation were due to cobalt 60, scandium 46, iron 59, lanthanum 140, and sodium 24. Cobalt 60 was significant only for irradiation times of an order equal to or greater than its half-life. For most projected nuclear tests, scandium 46 and iron 59 had the most significant activities. The ratio of cobalt to iron had a value of 0.0045±0.00025 by weight for the materials tested. Author

N67-24484# Naval Air Engineering Center, Philadelphia, Pa. Aeronautical Materials Lab.
DEVELOPMENT OF AN AIRCRAFT UPHOLSTERY FABRIC IN A STANDARD CONSTRUCTION (FIRE AND FLAME RESISTANT) Final Report, 7 Feb.–31 Dec. 1966
Margaret B. Hays 9 Jan. 1967 23 p refs
(NAEC-AML-2553; AD-647826) CFSTI: HC$3.00/MF$0.65

Four fabrics from commercial sources and 3 from a contract sample maker were studied as replacements for current nylon ribbed aircraft upholstery cloth for naval airplane seats. The goal was to develop a standard construction upholstery material with improved flame resistance and if possible to reduce the cost per yard. Fabrics of blended fibers, 50% cotton with 50% nylon known as Nyco, did not exhibit the melt drop characteristic of nylon. Neither of the 2 tested Nyco fabrics meet both appearance and service construction goals. Author (TAB)

N67-24599 Frieseke und Hoepfner G.m.b.H., Erlangen-bruck (Germany).
THICKNESS MEASUREMENTS ON HOT GLASS SHEETS IN THE MANUFACTURE OF PLATE GLASS [DICKENMESSUNG AN HEISSEN GLASBAHNEN BEI DER HERSTELLUNG VON TAFELGLAS]
H. Langel Brussels, EURATOM, Feb. 1967 39 p refs In GERMAN; ENGLISH summary
(Contract EURATOM-016-62-12 IRAD)
(EUR-3269.d) CFSTI: HC$3.00/MF$0.65

In order to try out radioactive thickness measurements in the plate glass industry, one prototype was developed and tested for each of three different modes of employment. The devices use a transmission technique with Am-241 gamma radiation. All are working satisfactorily. The object of the development work was achieved. The device for measurement in the cooling furnace is the most expensive, but has great advantages for the user. In spite of the great difficulty of the measurement problem this plant has good prospects of coming into widespread use. For some applications the plant for measuring behind the cooling furnace will also be of importance. Owing to the much reduced difficulty its cost is relatively low. Although the measuring equipment conferred no important advantages when used during vertical drawing, its use in other cases cannot be ruled out. Author

N67-24630*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
HIGH TEMPERATURE POLYIMIDES FOR ELECTRICAL EQUIPMENT
Bobby W. Kennedy 24 Feb. 1967 51 p refs
(NASA-TM-X-53523) CFSTI: HC$3.00/MF$0.65 CSCL 11I

Polyimide materials, such as H-film (pyromellitic dianhydride), molding compounds, and adhesives, that can be used in electronic equipment and withstand space and lunar environments, have been studied. The H-film, a polyimide with the ability to maintain its physical, electrical, and mechanical properties over a wide temperature range, is expected to withstand the high vacuum on the moon. It has a chain of rings in its skeleton instead of a single chain. The carbon ring absorbs energy without degradation; under the same conditions, a single chain would rupture. The adhesive systems used in laminating H-film will have approximately the same properties as H-film. An example is benzophenoneteracarboxylic dianhydride (BTDA) reacted with oxydianiline (ODA) in which the thermal stability appears to be similar to that of H-film. This adhesive system decomposes within 20 hours at 400°C. It shows relatively small weight losses at 300°C during the same period. Author

N67-24754# Alfred Univ., N. Y. College of Ceramics.
THE MECHANICAL BEHAVIOR OF STRONTIUM ZIRCONATE Final Report, Oct. 15, 1965–Oct. 14, 1966
J. E. Funk, J. Nemeth, and J. R. Tinklepaugh 15 Oct. 1966 60 p refs
(Contract NOw-66-0191-d)
(AD-646925) CFSTI: HC$3.00/MF$0.65

Yielding perovskites such as SrZrO3, CaZrO3 and BaTiO3 exhibit less notch sensitivity than was expected. A considerable amount of yield, without increase in stress, was observed in notched strontium zirconate samples having some porosity. It is speculated that free surface, increased by the flaws introduced by the notch and by the presence of some porosity, permitted uninhibited domain motion in grains exposed to that surface. It was observed that domain motion in perovskites under mechanical stress may be influenced by more than crystallographic shear angle. The defect structure in terms of the A cation and oxygen vacancies may affect both domain crystallography and the ease of domain motion. Iron was found to be a most useful addition to promote sintering in strontium zirconate. TAB

N67-24778# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A METHOD OF PRODUCING PHOSPHORUS-CONTAINING POLYESTERS

V. I. Kodolov and S. S. Spasskiy 31 Oct. 1966 7 p Transl. into ENGLISH from Russian Patent No. 170663 (Appl. no 88639/23-5, 16 Mar. 1964) 4 p
(FTD-HT-66-95; AD-646711) CFSTI: HC$3.00/MF$0.65

The object of the invention is a method of producing phosphorus-containing polyesters by polycondensation of phosphoric dichlorides with dioxy compounds. It is different in that, to produce phosphorus-containing polyesters with double bonds along the ends of the chain and also to expand the assortment of unsaturated phosphorus-containing polyesters, chloroanhydrides of an unsaturated acid (for example, methacrylic) are added to the reaction mixture. TAB

N67-24859# Research Triangle Inst., Durham, N.C.
STRUCTURE OF DRAWN POLYMERS Final Report, 1 Nov. 1964–30 Nov. 1966
A. Peterlin Dec. 1966 180 p refs
(Contract AF 33(615)-2244)
(AFML-TR-67-6; AD-647832) CFSTI: HC$3.00/MF$0.65

Morphology of deformed single crystals and of microfibrils pulled off at cracks, and chain mobility of cold drawn samples of polyethylene, polyoxymethylene, polyethylene oxide and polyamides were investigated using electron microscopy, electron diffraction and nuclear magnetic resonance. Most data were collected with polyethylene of low branching which among the polymers investigated has the simplest molecular and unit cell structure. Author (TAB)

N67-24861# Aberdeen Proving Ground, Md. Coating and Chemical Lab.
CHEMICAL ASPECTS OF DECOMPOSITION OF BRAKE FLUIDS: BRAKE FLUID SEDIMENT CAUSED BY RUBBER CUPS
Jules B. Counts Jan. 1967 16 p refs
(CCL-221; AD-647167)

The object of the investigation was to determine the cause and nature of excessive sedimentation found in brake fluids after testing and operation. Analysis showed this sediment to be essentially zinc stearate which had been formed from the reaction of zinc oxide and stearic acid leached from the rubber cups. The implications and possible remedies of this problem are discussed. Author (TAB)

N67-24884# Naval Radiological Defense Lab., San Francisco, Calif.
THE PYROLYSIS OF CELLULOSIC AND SYNTHETIC MATERIALS IN A FIRE ENVIRONMENT
Anne E. Lipska 14 Dec. 1966 46 p refs
(USNRDL-TR-1113; AD-645858) CFSTI: HC$3.00/MF$0.65

Existing knowledge on the pyrolysis and oxidation of cellulosic and synthetic materials is summarized. Included are the various studies on the thermal degradation of polymers, methods of heating and analyzing the decomposition products and the current theories on the mechanisms of pyrolysis of these materials. In addition, fire retardants and the toxic hazards resulting from the thermal degradation of the materials found in a fire environment are discussed. Recommendations for further experimental effort leading toward a better understanding of the pyrolytic processes involved in a fire environment are presented. A comprehensive bibliography (101 references) is included. Author (TAB)

N67-24895# Northwestern Univ., Evanston, Ill.
PLASTICITY AND FRACTURE OF CERAMICS Final Report
J. O. Brittain 31 Dec. 1966 18 p
(Contract Nonr-1228(17))
(AD-647625) CFSTI: HC$3.00/MF$0.65

An investigation was made to study the effects of the defect state and structure of ionic compounds upon their mechanical properties. The properties studied included creep, internal friction, surface energy, yielding and flow, optical properties, and resistivity. The principle materials used were rutile (TiO2), magnesium oxide (MgO), Lithium Fluoride (LiF), and a eutectic LiF-NaF. Author (TAB)

N67-24909# Naval Ordnance Lab., White Oak, Md. Chemistry Research Dept.
HIGH VISCOSITY THERMAL PROTECTION MATERIALS Summary Report, 30 Jun. 1965–30 Jun. 1966
Roger E. Wilson and D. M. Caum 16 Dec. 1966 35 p refs
(NOLTR-66-213; AD-646616) CFSTI: HC$3.00/MF$0.65

Processes were developed for hot pressing a 68.5% tungsten-31.5% silica composition to over 97% of the calculated theoretical density. Hot pressing characteristics changed when crystalline silica was substituted for vitreous silica. Grinding and hot pressing methods were studied for fabricating test nozzles for the NOL oxyhydrogen rocket motor. Gases entrapped during hot pressing are expected to be a factor in ablation performance. Vacuum-argon sintering of the silica-tungsten mixture was studied and photomicrographs revealed a structure similar to that of the Bjorksten Laboratory specimens but different from that of hot pressed material. Author (TAB)

N67-24932# Rutgers Univ., New Brunswick, N.J. School of Chemistry.
THE DEHYDRATION OF POROUS GLASS
M. J. D. Low and N. Ramasubramanian 1 Mar. 1967 24 p refs
(Contract Nonr-404(19))
(TR-5; AD-647303) CFSTI: HC$3.00/MF$0.65

A microbalance was used to follow the kinetics of dehydration of porous glass in vacuo at constant temperatures from 25C to 800C. The kinetics of water sorption and desorption by the degassed surfaces was measured. Infrared spectra of degassed specimens were obtained. Physically adsorbed water as well as some tightly-bound water could be removed at 25C. Degassing above 600C produces surfaces containing isolated hydroxyls. The amount of water retained after a sorption-desorption cycle is a maximum with samples degassed near 300C. It is proposed that geminal hydroxyls responsible for this maximum are destroyed. The percentage of the sorbed water which is retained increases with samples degassed above 600C. This effect is produced by boron migrating to the surface of the glass. Author (TAB)

N67-24946# Naval Ordnance Lab., White Oak, Md.
HIGH TEMPERATURE RESISTANT MATERIALS FOR MISSILE PROPULSION SYSTEMS Summary Report, 30 Jun. 1965–30 Jun. 1966
D. M. Caum, B. T. Hartmann, and F. J. Koubek 27 Dec. 1966 51 p refs
(NOLTR-66-214; AD-647309) CFSTI: HC$3.00/MF$0.65

A temperature prediction program showed agreement to within 10 to 25% of experimental internal temperature for three ablators tested in the oxy-acetylene burner. However, if alpha (effective thermal diffusivity) is not obtained under steady-state ablation conditions, the agreement could be several hundred per cent in error. The alpha-rod test technique was found to be useful for ablators with widely varying properties. The NOL oxy-acetylene panel test was accepted and published as a tentative ASTM method. Author (TAB)

N67-24966# Pennsalt Chemicals Corp., King of Prussia, Pa.
RESEARCH AND DEVELOPMENT STUDIES ON WATER-REPELLENT ANTISTATIC COATINGS, MULTI-PURPOSE FLUID THICKENERS AND THERMALLY STABLE ELASTOMERIC POLYMERS Final Report, 18 Feb.–17 Aug. 1966
Anthony J. Saraceno, Oliver S. Sprout, Andrew J. Hamilton, Jr., and B. Peter Block Sep. 1966 56 p refs
(Contract N156-46781)
(AD-647072) CFSTI: HC $3.00/MF $0.65

Water-repellent and transparent antistatic coatings of (Cr (H2O) (OH) (OP (Me) (Ph)O)2)x and (Cr (H2O) (OH) (OPPh2O)2)x as TCP plasticized compositions dissipated a positive charge of 5000 volts to zero in 7.5 and 45.0 seconds, respectively. Volume resistivity measurements of CHCl3 stock solutions of these materials show they are the most conductive of the phosphinates tested. End-capping appears detrimental to antistatic performance. Grease thickener studies showed good gelling efficiency and antiwear properties with 10% of the acetate end-capped chromium hydroxyaquo (methyl-phenyl-dioctylphosphinate) copolymer in a poly (methylphenylsiloxane) DC 550 base. Studies to improve the functional thermal stability of polyphosphinate-thickened greases is continuing. Rigidity and tensile strength of (Zn (OPBu2O)2-Zn (OP (C8H17)2O)2) are barely improved by the use of benzoyl peroxide or by the peroxide with a chromium phosphinate. Through cross-linking of (Cr (H2O) (OH) (OPR2O)2) polymers by phosphinic acids, tensile strengths or in some cases, elongation have been increased considerably. Author (TAB)

N67-25014*# International Information, Inc., Philadelphia, Pa.
ION EXCHANGE AND INCREASING THE STRENGTH OF GLASS [IONNYY O BMEN I POVYSHENIYE PROCHNOSTI STEKLA]
O. K. Botvinkin and O. N. Denisenko Washington, NASA, Apr. 1967 6 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Neorgan. Materialy (Moscow), v. 2, no. 11, 1966 p 2029–2033
(Contract NASw-1499)
(NASA-TT-F-10846) CFSTI: HC $3.00/MF $0.65 CSCL 11B

The stress coefficients in glass resulting from ion exchange were determined and calculated. Author

N67-25069*# TRW Systems Group., Redondo Beach, Calif.
PROCESS SPECIFICATION: APPLICATION OF FOAM-IN-PLACE POLYURETHANE TO HIGH VOLTAGE DEVICES
C. J. Holzbauer Apr. 1967 10 p
(Contract NAS3-8905)
(NASA-CR-72098; TRW-06378-6007-R002) CFSTI: HC $3.00/MF $0.65 CSCL 11I

Details are given on the materials, procedures, and controls to be used in encapsulating high-voltage direct-current electrical assemblies with polyurethane foam. Health and safety precautions are considered, including toxicity, flammability, and ventilation. The materials to be used for the foaming process are described, i.e., foam systems, mold releases and maskants, cleaning materials, and equipment. Procedures are outlined for mold preparation, electrical assembly preparation, selection of foam, and foam formulation. Workmanship and rework are also discussed as well as quality assurance provisions and preparation for delivery. L.E.W.

N67-25076* Aerojet-General Corp., Azusa, Calif. Von Karman Center.
CRYOGENIC RESINS FOR GLASS-FILAMENT-WOUND COMPOSITES Final Report, 6 May 1965–31 Dec. 1966
Louis M. Soffer and Ralph Molho Jan. 1967 241 p refs
(Contract NAS3-6287)
(NASA-CR-72114; Rept.-3343) CSCL 11I

A modified epoxy system, Resin 2, was developed for use in cryogenic applications of glass filament-wound composite structures. It was selected from 41 initial candidates in a three-phase program consisting of resin formulation, physical screening, and physical and mechanical testing. Candidate resins were evaluated for their adaptability to conventional filament-winding techniques, cast-resin properties, and performance as glass filament-wound composite specimens. The structural properties of Resin 2 as a matrix were then compared with a standard epoxy resin in a series of single-cycle burst tests on metal-lined glass filament-wound composite pressure vessels. At cryogenic temperatures, Resin 2 exhibited longitudinal filament stresses that were 15.4 and 6.6% greater respectively, than those obtained in vessels fabricated from the standard epoxy resin. At ambient temperature, the performance of the two systems was essentially the same. Author

N67-25077*# TRW Systems Group, Redondo Beach, Calif.
DESIGN GUIDE FOR USE OF POLYURETHANE FOAM AS AN ENCAPSULANT FOR HIGH VOLTAGE DEVICES
C. J. Holzbauer Apr. 1967 7 p refs
(Contract NS3-8905)
(NASA-CR-72099; TRW-06378-6007-R001) CFSTI: HC $3.00/MF $0.65 CSCL 11I

Design guides are given for the application of foam-in-place polyurethanes as encapsulants for high voltage devices for use in the space environment. Physical, mechanical, dynamic, and electrical properties of the preferred materials are presented in tabular form. Design requirements are also discussed, including tolerances, holes, draft, and inserts, studs and similar hardware. L.E.W.

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N67-23496# Applied Physics Lab., John Hopkins Univ., Silver Spring, Md.
SOME PROBLEMS IN THE THEORY OF APPROXIMATING SOLUTIONS OF DIFFERENTIAL-OPERATOR EQUATIONS IN HILBERT SPACE
L. Kh. Liberman 28 Nov. 1966 12 p refs Transl. into ENGLISH from Izv. Vysshikh Uchea. Zaved., Mat. (Kazan), v. 40, no. 3, 1964 p 88–92
(Contract NOw-62-0604-c)
(TG-230-T508; TT-67-60450; AD-645720) CFSTI: HC $3.00/MF $0.65

In the present paper the author studies certain aspects of the theory of approximating nonlinear differential-operator equations of the form dx/dt = f (x, t) + phi (c sub 1,... c sub m, u sub 1 (t),... u sub n (t),t), where f(x,t) and phi (c sub 1,... , c sub m, u sub 1 (t), ... u sub n (t),t) are nonlinear operators satisfying certain conditions; x,u sub 1, ... u sub n for given t are elements of a Hilbert space; and c sub 1, c sub 2, ... c sub m are numbers. An effective method is presented for choosing the functions u sub 1 (t), u sub 2 (t), ... u sub n (t), called control functions, and the parameters c sub 1, ... c sub m, in order for the given function y(t) to have the least mean square deviation from the solution x(t) of equation. A relationship is pointed out between certain aspects of the stability of solutions of the equation and problems in the theory of approximating solutions. TAB

N67-23611# Northwestern Univ., Evanston, Ill. Information-Processing and Control Systems Lab.
ON BALANCED SETS, CORES, AND LINEAR PROGRAMMING

A. Charnes and K. Kortanek (Cornell Univ.) Jan. 1967 27 p refs Prepared jointly with Cornell Univ.
(Contract N00014-66-C0020-A03; Grant NIH G-ES-0098-01)
(TR-67-101; AD-645490) CFSTI: HC $3.00/MF $0.65

L. S. Shapley has found a necessary and sufficient condition for the non-emptiness of the core of a characteristic function n-person game stating that the core is non-empty if and only if a certain system of linear inequalities on minimal balanced collection of finite sets is consistent. Using some well known constructs of linear programming, the authors associate to any n-person game two dual linear programming problems in which the constraint set of the primal includes the core of the game, and characterize the non-emptiness of the core in terms of properties of dual optimal solutions of these problems. They then prove the Shapley conjecture on sharpness of the set of proper minimal balanced inequalities with respect to core feasibility of proper n-person games. Using the Farkas-Minkowski Theorem, they obtain a characterization of redundant inequalities with respect to core feasibility and express the rate of growth of the game as a sequence of lower bounds for successive game values corresponding to increasing subsets of the collection of N players, which vitiates the possibility of constraint redundancy. If all game values are non-negative, the characteristic growth rate induces a partial ordering on game values corresponding to subsets of N. Author (TAB)

N67-23629# California Univ., Berkeley. Dept. of Mathematics.
L-FUZZY SETS
Joseph A. Goguen Sep. 1966 58 p refs
(Contracts Nonr-3656(08); Nonr-222(85))
(AD-645235) CFSTI: HC $3.00/MF $0.65

The paper develops the machinery of a theory of sets whose boundaries are fuzzy. It applies to situations involving uncertainty or ambiguity which is not statistical in nature, such as pattern classification, and some applications are discussed. Section titles include: L-fuzzy Sets; The Structure of L; Fuzzification; Categories and the Composition of Fuzzy Maps; Relations; Images; Decisions and Mappings between Lattices. Author (TAB)

N67-23639# System Development Corp., Santa Monica, Calif.
ON THE CONSTRUCTION OF LATIN AND LATTICE SQUARES AND OTHER INCOMPLETE BLOCK DESIGNS
N. E. Willmorth 1 Dec. 1966 38 p refs
(Contract DA-49-092-ARO-65)
(SP-2664; AD-645154) CFSTI: HC $3.00/MF $0.65

Limitations on the availability of experimental materials, subjects, time, and equipment lead to the use of incomplete block designs. This paper discusses the construction of incomplete blocks for (p(m))n systems (where p is a prime), using finite field geometry as the construction method. A table of primitive irreducible polynomials for p(n) < 1000 is given. Methods for factorial representation, computation of confounded effects, and generation of incomplete blocks are demonstrated; and some of the interrelationships of Graeco-Latin, lattice, and partial factorial designs are demonstrated. Author (TAB)

N67-23643*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SCIENTIFIC PROGRAMMING
E. M. Keberle *In its* Supporting Res. and Advanced Develop. 28 Feb. 1967 p 33-51 refs (See N67-23641 12-11)

Transformations are considered for direction fields by solving partial differential equations of the directional type, as well as for the autonomous systems of ordinary differential equations that are dependent upon these equations. Applications to propulsion research are discussed for the latter, and tranformations of the boundary layer equation to monotonous forms are considered. For the direction fields transformation, the initial value problem for quasilinear partial differential equations, conditions for level-lines of solutions, and the Estabrook-Wohlquist functions as new variables are considered. The electron-optical potential optimization series for a star tracker is described, and the integro-differential equations are presented. M.W.R.

N67-23701 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HERALD OF MOSCOW UNIVERSITY SERIES I: MATHEMATICS AND MECHANICS
18 Aug. 1966 122 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. I: Mat. i Mekhan. (Moscow), v. 19, no. 1, 1964 p 1-80
(FTD-MT-64-557; TT-67-60486; AD-645789) CFSTI: $3.00

CONTENTS:

1. NEW FORM OF NOTATION OF STOCHASTIC INTEGRALS AND EQUATIONS R. L. Stratonovich p 1-13 refs (See N67-23702 12-19)

2. ARITHMETICAL PROPERTIES OF SOLUTIONS OF A TRANSCENDENTAL EQUATION N. I. Fel'dman p 15-24 refs (See N67-23703 12-19)

3. SCHROEDINGER EQUATION FOR SYSTEM OF ONE-DIMENSIONAL PARTICLES WITH POINT INTERACTION F. A. Berezin, G. P. Pokhil, and V. M. Finkel'berg p 25-35 refs (See N67-23704 12-19)

4. ON THE SPECTRUM OF NONSELF-ADJOINT STURM—LIOUVILLE OPERATOR M. M. Gekhtman p 37-45 refs (See N67-23705 12-19)

5. ON EXAMPLES OF NONUNIQUENESS OF ANALYTIC FUNCTIONS A. A. Gonchar p 47-55 refs (See N67-23706 12-19)

6. CONTINUOUS AND SEQUENTIAL LIMITS OF MEROMORPHIC AND GENERALIZED MEROMORPHIC FUNCTIONS IN A UNIT CIRCLE V. I. Gavrilov p 57-74 refs (See N67-23707 12-19)

7. PARAMETRIC EXCITATION OF WAVES ON THE SURFACE OF A LIQUID BY AN ALTERNATING ELECTRIC FIELD S. V. Nesterov p 75-79 refs (See N67-23708 12-23)

8. ON NONLINEAR FLUTTER OF PLATES V. G. Kotyukov p 81-86 refs (See N67-23709 12-32)

9. SOLUTION OF PROBLEM OF TORSIONAL IMPACT BY METHOD OF SUCCESSIVE APPROXIMATION R. I. Nadeyeva p 87-91 refs (See N67-23710 12-32)

10. ON GEOMETRIC TREATMENT OF THEORY OF DISLOCATIONS B. Ye. Pobedrya p 93-103 refs (See N67-23711 12-32)

11. ON THE MOTION OF A GYROSTAT; FIXED AT A SINGLE MOTIONLESS POINT I. A. Keys p 105-109 refs (See N67-23712 12-23)

N67-23702# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NEW FORM OF NOTATION OF STOCHASTIC INTEGRALS AND EQUATIONS
R. L. Stratonovich *In its* Herald of Moscow Univ. Ser. I: Math. and Mech. 18 Aug. 1966 p 1-13 refs (See N67-23701 12-19) CFSTI: HC $3.00/MF $0.65

A new method of defining stochastic integrals and equations is proposed which allows them to be transformed according to the conventional rules valid for expressions involving smooth functions. Contravariant vector parameters of Kolmogoroff's equations are introduced. Author

N67-23703# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ARITHMETICAL PROPERTIES OF SOLUTIONS OF A TRANSCENDENTAL EQUATION

N. I. Fel'dman *In its* Herald of Moscow Univ. Ser. I: Math. and Mech. 18 Aug. 1966 p 15–24 refs (See N67-23701 12-19)
CFSTI: HC $3.00/MF $0.65

Given the equation $P(z, z^{\alpha})=0$ where α is an algebraic irrational number and $P(x,y)$ is a polynomial in x and y with integral rational coefficients which contains and x and y; approximations of the proposed equation are performed using algebraic numbers where there is assumed irreducibility of the polynomial. S.C.W.

N67-23704 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SCHROEDINGER EQUATION FOR SYSTEM OF ONE-DIMENSIONAL PARTICLES WITH POINT INTERACTION
F. A. Berezin, G. P. Pokhil, and V. M. Finkel'berg *In its* Herald of Moscow Univ. Ser. I: Math. and Mech. 18 Aug. 1966 p 25–35 refs (See N67-23701 12-19)

The solution of the Schrodinger equation for n one-dimensional particles with point interaction is obtained in explicit form. The ψ-functions of the scattering theory are found and their completeness is proved. The scattering operator is constructed and its eigenfunctions together with scattering phases are found. Author

N67-23705 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE SPECTRUM OF NONSELF-ADJOINT STURM—LIOUVILLE OPERATOR
M. M. Gekhtman *In its* Herald of Moscow Univ. Ser. I: Math and Mech. 18 Aug. 1966 p 37–45 refs (See N67-23701 12-19)
CFSTI: HC $3.00/MF $0.65

Assuming that in $L^2(0,\infty)$ there is a given operator L, such that $Ly=-y'' + (q+ir)y$; $y'(0) - \theta y(0)=0$, and where $q(x)$, $r(x)$, and $\theta \neq \infty$ are real functions, the following theorem is proven: If $r(x) \to 0$ as $x \to \infty$, then the spectrum of the operator L lies in the complex λ-plane ($\lambda=\sigma+i\tau$) in the domain $|\tau| \leq K(\sigma)$ where $K(\sigma)$ is a nonnegative function satisfying the condition $K(\sigma) \to 0$ as $\sigma \to \infty$. Author

N67-23706 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON EXAMPLES OF NONUNIQUENESS OF ANALYTIC FUNCTIONS
A. A. Gonchar *In its* Herald of Moscow Univ. Ser. I: Math. and Mech. 18 Aug. 1966 p 47–55 refs (See N67-23701 12-19)
CFSTI: HC $3.00/MF $0.65

It is shown that if closed domain P_{δ} satisfies the conditions such that: $f(z) \in A(P_{\delta})$, $f(z)$ is infinitely differentiable on $\overline{P}_{\delta}$ (with respect to $\overline{P}_{\delta}$), $f^{(p)}(z)=0$ and $p=0, 1, 2, \ldots$; $|z| \geq 1$, and $f(z) \not\equiv 0$, $z \in \overline{P}_{\delta}$; $\delta (0<\delta \leq 1)$ is any number; then, for any function $F_0(z)$ analytic on C there exists the function $F(z) \in A(P_{\delta})$, which is infinitely differentiable on P_{δ} (with respect to P_{δ}) such that $F_0^{(p)}(z)=F^{(p)}(z)$ for $p=0, 1, 2 \ldots$ and $|z| = 1$. It is further shown that it is sufficient to represent the function $F_0(z)$, $z \in C$ in the form $f_0(z)+f_1(z)$, where $f_0(z)$ is analytic on set $|z| \geq 1$, $f_0(\infty)=0$, and $f_1(z)$ is analytic in closed circle $|z| \leq 1$. S.C.W.

N67-23707 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONTINUOUS AND SEQUENTIAL LIMITS OF MEROMORPHIC AND GENERALIZED MEROMORPHIC FUNCTIONS IN A UNIT CIRCLE
V. I. Gavrilov *In its* Herald of Moscow Univ. Ser. I: Math. and Mech. 18 Aug. 1966 p 57–74 refs (See N67-23701 12-19)

Presented is a mathematical analysis of the boundary behavior of normal generalized meromorphic functions in the unit circle (D) which has an asymptotic value along the Jordan curve from D; and the behavior of functions which are normal generalized meromorphic functions in D on dense sequences of points of D, which converge to the boundary Γ. The analysis is based on the assumption that any function which is a generalized meromorphic function in D is representable in the form of a super-poeition of a meromorphic function and a one-sheeted Q-quasi-conformal mapping. The validity of the proposed assumption is established first for meromorphic functions; and using properties of one-sheeted Q-quasi-conformal mappings, is extended to generalized meromorphic functions. S.C.W.

N67-23719*# North American Aviation, Inc., Downey, Calif.
PERIODIC SOLUTIONS FOR THE RESTRICTED THREE-BODY PROBLEM OF CELESTIAL MECHANICS
P. Lanzano Washington, NASA, May 1967 47 p refs
(Contract NASw-1309)
(NASA-CR-765) CFSTI: HC $3.00/MF $0.65 CSCL 03B

A study designed to analyze intrinsic properties of periodic solutions for the circular problem, and periodic solutions about a Lagrangian point, is reported. The curvature of the generic orbit is expressed in terms of the velocity field and the angle that the orbit makes with the zero-velocity curves, obtainable from the Jacobi integral. An application of this intrinsic representation is given for a periodic orbit, whereby the period of the orbit can be expressed as a double integral extended to the area bounded by the closed curve. Also, the existence of periodic orbits, which can be considered as an infinitesimal isoenergetic displacement of a given periodic orbit, is proven by ascertaining periodic solutions to a Mathieu equation. A series representation of periodic solutions about a Lagrangian triangular point is presented. Two families of periodic solutions were obtained. The synodic coordinates of the orbits are expressed as trigonometric series of time, the coefficients of the various harmonics depending on a real parameter related to the initial conditions. Author

N67-23823# Nebraska Univ., Lincoln.
ON A NEW PROPERTY OF PBIB DESIGNS USEFUL IN AN APPLICATION OF MANOVA IN PSYCHOMETRICS Scientific Interim Report, Sep. 1965–Aug. 1966
Jagdish N. Srivastava and Russell L. Maik Jun. 1966 17 p refs
(Contract AF 33(615)-3231)
(ARL-66-0105; AD-640217) CFSTI: HC $3.00/MF $0.65

The work includes an interesting property of a partially balanced association scheme, which is important in an application of multivariate analysis of variance, discussed earlier in a paper by Srivastava (on testing hypotheses regarding a class of covariance structures). TAB

N67-23864# Stanford Univ., Calif. Dept. of Industrial Engineering.
EFFICIENT SUBOPTIMAL ALGORITHMS FOR INTEGER LINEAR PROGRAMMING WITH AN INTERIOR
Frederick S. Hillier 12 Aug. 1966 45 p refs
(Contract Nonr-225(89); Grant NSF GP-3739)
(TR-2; AD-640382)

The paper presents and evaluates some new suboptimal algorithms for the pure integer linear programming problem having only inequality constraints. The computation time required by these algorithms (after obtaining the optimal noninteger solution) has been only a small fraction of that required by the simplex method. Furthermore, the solution obtained by the better algorithms consistently has been close to optimal and frequently has actually been optimal. Plans for generalizing these algorithms also are outlined. A companion paper presents an optimal 'bound-and-scan' algorithm that would be used in conjunction with these suboptimal algorithms. TAB

N67-23873# Purdue Univ., Lafayette, Ind. Dept. of Statistics.
ON OUTSTANDING VALUES IN A SEQUENCE OF RANDOM VARIABLES
Mahabanoo N. Tata Jan. 1967 39 p refs Its Mimeograph Ser. No. 97
(Contract Nonr-1100(26))
(AD-645831) CFSTI: HC $3.00/MF $0.65

The report considers a sequence (X sub n, n > or = 1) of independent, identically distributed and absolutely continuous random variables. X sub j is called an outstanding value in the sequence X sub n if X sub j > max (X sub 1, ... , X sub j - 1). By convention X sub 1 is outstanding. Let L sub 0 = 1 and n > or 1 define L sub n = min (j:j > L sub n-1, X sub j is outstanding), delta sub n = L sub n - L sub n-1. TAB

N67-23907# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TRANSFORMATION OF LOGICAL SYSTEMS OF ALGORITHMS
V. F. D'yechenko *In its* Acad. of Sci. of the USSR. Inst. of Inform. Transmission. Probl of Inform. Transmission 18 Aug. 1966 p 1–19 refs (See N67-23906 12-14)

Equivalent transformations of logical systems of algorithms can be used to carry out transformations of programs to reduce the operations and time needed to solve the problem. A system of transition formulas and their identical transformations are described for the transformation of logical systems of algorithms. R.N.A.

N67-23965*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TWO-POINT TAYLOR SERIES EXPANSIONS
R. H. Estes and E. R. Lancaster Dec. 1966 13 p refs
(NASA-TM-X-55759; X-643-66-567) CFSTI: HC $3.00/MF $0.65
CSCL 12A

The Taylor series is extended to include two points about which a function may be expanded. The virtue of this procedure lies in the fact that the accuracy of using 2n derivatives in a one-point Taylor series is attained using only n derivatives with the two-point expansion. The coefficients of the expanded series are calculated; and a solution of the two body problem applying the expansion is presented. Curves showing a comparison of the resulting solutions for the two body problem from the two-point Taylor series and one-point Taylor series expanded about t_1 are depicted. The curves indicate the error in the calculation of the magnitude of the radius vector vs the time of orbit. L.S.

N67-24004# California Univ., Berkeley. Operations Research Center.
CLOSED NETWORKS OF QUEUES
Richard J. Swersey Jan. 1967 62 p refs
(Contract Nonr-222(83); Grant NSF GP-4593)
(ORC-67-1; AD-646233) CFSTI: HC $3.00/MF $0.65

A closed network of queues consists of a finite set of N customers, a finite set of M single-channel servers, and a set of arcs (i,j) which represent the allowed instantaneous movement from station i to station j. One also assumes that all customers are identical in their stochastic behavior, that movement is governed by a set of given transition probabilities such that they form an irreducible Markov chain, that service times are governed by an exponential distribution, and that the imbedded Markov chain defined on the instants of service completions is irreducible. Under these assumptions steady-state operating characteristics are derived through analyses of the time-average steady-state equations and of the underlying Markov chain. The general results are specialized to cyclic queues and to open networks of queues (jobshop-like queuing systems); the structure of the steady-state probabilities is the same as that of the cyclic queue. It is also shown that the results can be generalized to a multi-channel server problem and that the number of customers at a given service center has an IFR (increasing failure rate) distribution. Optimal allocation of labor (servers) from a fixed pool is considered and it is shown that, in a cyclic queue, maximum output is achieved from an equal allocation of labor to each service center. A discrete optimization problem is then considered for a more general network that represents the operation of an airlines maintenance base. Author (TAB)

N67-24013# Air Force Systems Command, Wright-Patterson AFB, Ohio. Systems Engineering Group.
A METHOD FOR CALCULATING POLYNOMIALS OF BEST APPROXIMATION Technical Report, 1 Jun.–1 Sep. 1964
Alfred Oliver (M.S. Thesis—Ohio State Univ.) Aug. 1966 31 p refs
(SEG-TR-66-32; AD-645052) CFSTI: HC $3.00/MF $0.65

The report deals with minimax approximations to functions defined on the real line. These approximations are of particular use to mathematicians having access to a digital computer facility. The cases considered are for functions defined as discrete points on the Cartesian plane and for continuous, bounded functions defined on a closed interval of the real line. A method for obtaining the approximations using linear programming techniques is presented for each case. An analysis of the error function and a brief outline of the computer program are included. Author (TAB)

N67-24019# Douglas Aircraft Co., Inc., Huntington Beach, Calif. Advanced Research Labs.
ANALYTICITY PROPERTIES OF UNITARY INTEGRALS
Donald A. Jacobsen Dec. 1966 58 p refs *Its* Res. Commun. No. 19
(Douglas Paper-4247; AD-644991) CFSTI: HC $3.00/MF $0.65

A general unitary integral is analytically continued. The purpose being to obtain the domain of holomorphy of the integral in terms of the domains of holomorphy of the amplitudes occurring in the integrand. The amplitudes are assumed to be analytic on Riemann domains whose structure is restricted only by certain assumptions found to be prerequisites for an analytic continuation of the unitary integral. The Riemann domains allow for the possibility of an infinite number of singularities of an arbitrary type, and natural boundaries may occur. The analytic continuation is carried out explicitly in terms of scalar variables. All difficulties associated with the use of scalar variables are resolved to give an analytic continuation paralleling that in momentum space. Author (TAB)

N67-24231# Brookhaven National Lab., Upton, N. Y. Applied Mathematics Dept.
SUMMER INSTITUTE ON SPECTRAL THEORY AND STATISTICAL MECHANICS, 1965
Joel David Pincus, ed. Nov. 1966 350 p refs Meeting held in Upton, N. Y., Jun. 1965; sponsored by AEC
(BNL-993(T-422) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. THEORY AND APPLICATIONS OF TOEPLITZ FORMS M. Kac (Rockefeller Inst.) p 1–56 ref (See N67-24232 12-19)
2. A SINGULAR RIEMANN HILBERT PROBLEM J. D. Pincus (Brookhaven Natl. Lab.) p 57–92 refs (See N67-24233 12-19)
3. THE REFINED SZEGOE THEOREM AND ITS ANALOGS I. I. Hirschman (Wash. Univ.) p 93–134 ref (See N67-24234 12-19)
4. SELF-ADJOINT TOEPLITZ OPERATORS M. Rosenblum (Va. Univ.) p 135–157 (See N67-24235 12-19)
5. A MATHEMATICAL SURVEY OF A CLASS OF APPROXIMATIONS TO THE BOLTZMANN EQUATION J. K. Thurber

(Brookhaven Natl. Lab.) p 158–190 refs (See N67-24236 12-19)

6. SOUND PROPAGATION L. Sirovich (Brown Univ.) p 191–221 refs (See N67-24237 12-23)

7. THE METHOD OF AVERAGING. THE KINETIC EQUATION FOR MODERATELY DENSE GASES G. Ford (Mich. Univ.) p 222–263 refs (See N67-24238 12-12)

8. BROWNIAN MOTION MODELS R. J. Rubin (Natl. Bur. of Standards) p 264–297 refs (See N67-24239 12-23)

9. MATHEMATICAL PROBLEMS OF STATISTICAL MECHANICS M. Dresden (State Univ. of New York) p 298–338 (See N67-24240 12-23)

N67-24232# Rockefeller Inst., New York.
THEORY AND APPLICATIONS OF TOEPLITZ FORMS
Mark Kac *In* Brookhaven Natl. Lab. Summer Inst. on Spectral Theory and Statist. Mech., 1965 Nov. 1966 p 1–56 refs (See N67-24231 12-19)

The concept of Toeplitz matrix forms is introduced, and the behavior of the matrix is mathematically investigated. Applications of the matrices to (1) classical function theory, (2) prediction theory, (3) thermodynamics, (4) quantum statistical mechanics, and (5) random walk problems are discussed in detail. L.S.

N67-24233# Brookhaven National Lab., Upton, N. Y. Applied Mathematics Dept.
A SINGULAR RIEMANN HILBERT PROBLEM
Joel David Pincus *In its* Summer Inst. on Spectral Theory and Statist. Mech., 1965 Nov. 1966 p 57–92 refs (See N67-24231 12-19)

A method for explicitly diagonalizing certain self-adjoint operators having absolutely continuous spectral measure, is explored. The operators also have the property that the eigenfunction equation for the generalized eigenfunction belonging to the spectral value (all given) is equivalent to a special kind of singular Hilbert barrier relation for a sectionally holomorphic function canonically related to the generalized eigenfunction. It is shown that the geometry of the invariant subspaces of the barrier related operators is such that it is possible to obtain a complete orthonormal set of generalized eigenfunctions directly from the theory of the associated singular barrier problem. A complete spectral theory for a class of self-adjoint singular integral operators on a circle is derived as an example of problems which may arise. L.S.

N67-24234# Washington Univ., St. Louis, Mo. Dept. of Mathematics.
THE REFINED SZEGOE THEOREM AND ITS ANALOGS
I. I. Hirschman *In* Brookhaven Natl. Lab. Summer Inst. on Spectral Theory and Statist. Mech., 1965 Nov. 1966 p 93–134 refs

The theory of Szego orthogonal polynomials is discussed for a classical case. The concept is then generalized in order to obtain the Szego refinement, and analogs of the refinement. Definitions are stated, and arguments and theorem proofs are presented in detail. L.S.

N67-24235# Virginia Univ., Charlottesville.
SELF-ADJOINT TOEPLITZ OPERATORS
Marvin Rosenblum *In* Brookhaven Natl. Lab. Summer Inst. on Spectral Theory and Statist. Mech., 1965 Nov. 1966 p 135–157 (See N67-24231 12-19)

Mathematical examples involving Toeplitz, Hankel, Wiener-Hopf, bounded, and other operators for Hilbert space matrices, are presented. Generating function, orthonormal sets, and polynomials are detailed along with theorem proofs and corollaries. An application of the Toeplitz operator to the von Neumann spectral theorem is given. L.S.

N67-24236# Brookhaven National Lab., Upton, N. Y. Applied Mathematics Dept.
A MATHEMATICAL SURVEY OF A CLASS OF APPROXIMATIONS TO THE BOLTZMANN EQUATION
James K. Thurber *In its* Summer Inst. on Spectral Theory and Statist. Mech., 1965 Nov. 1966 p 158–190 refs (See N67-24231 12-19)

A survey of some basic results obtained for a class of approximations to the linearized Boltzmann equation, is presented. They are called model equations and are generalizations of the well known Bhatnager–Gross–Krook–Welander model. Kinetic model approximations to the linearized Boltzmann equation for a simple monatomic gas, are discussed. A simple model (the isosteric) is developed in detail to illustrate certain essential features of all the model equations. It is easy to deal with analytically. A proof of the asymptotic approach to hydrodynamics of solutions of linearizations of these model equations is outlined. Author

N67-24448*# Scientific Translation Service, La Canada, Calif.
BOUNDARY VALUE PROBLEMS FOR EQUATION $\epsilon y'' = f(x, y, y')$ FOR SMALL VALUES OF ϵ [O KRAYEVYKH ZADACHAKH DLYA URAVNENIYA $\epsilon y'' = f(x, y, y')$ PRI MALYKH ϵ]
N. I. Brish Washington, NASA, Mar. 1967 6 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 95, no. 3, 1954 p 429–432
(Contract NASw-1496)
(NASA-TT-F-10839) CFSTI: HC $3.00/MF $0.65 CSCL 12A

The behavior of solutions of several boundary value problems for the equation $\epsilon y'' = f(x, y, y')$ when ϵ tends toward zero is studied. Theorems are formulated, and the proof of these theorems is presented. Author

N67-24612*# National Aeronautics and Space Administration, Washington, D. C.
ON THE ASYMPTOTIC BEHAVIOR OF THE SOLUTIONS OF BOUNDARY PROBLEMS FOR QUASILINEAR DIFFERENTIAL EQUATIONS [OB ASIMPTOTIKE RESHENIYA KRAYEVYKH ZADACH DLYA KVAZILINEYNYKH DIFFERENTSIAL'NYKH URAVNENIY]
M. I. Vishik and L. A. Lyusternik May 1967 9 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 121, no. 5, 1958 p 778–781
(NASA-TT-F-484) CFSTI: HC $3.00/MF $0.65 CSCL 12A

The construction of asymptotic solutions, involving the small parameter ϵ, of boundary problems for nonlinear and quasilinear differential equations is demonstrated on the example of ordinary differential equations in a direction transverse to the boundary. Under assumption of the existence of a bounded M-domain a theorem of asymptotic representation, valid for the solution $y_\epsilon(x)$ of the ordinary differential equation lying in M, is proved by successive expansions in series of the linear case. Author

N67-24708# Parke Mathematical Labs., Inc., Carlisle, Mass.
A GENERALIZATION OF THE MOTZKIN THEOREM
Lorenzo Calabi and William E. Hartnett Nov. 1966 32 p refs
(Contract AF 19(628)-5711)
(SR-2; AFCRL-66-824; AD-646926) CFSTI: HC $3.00/MF $0.65

A figure A in the Euclidean plane is a compact set whose closed convex hull C(A) has a non empty interior; a ball of support for A is a closed ball which has points of A on the boundary but not in the interior. For each figure A, let C(A)-A denote the convex deficiency of A and let (S,q) denote the skeletal pair of A where S is the set of centers of maximal balls of support for A and q(x) is the distance from x to A for x∈S. The following statements are proved: (1) Two figures have equal convex deficiencies if they have equal skeletal pairs. (2) (Motzkins Theorem) A figure is convex if its skeleton is empty. (3) A figure is uniquely determined

by its closed convex hull and its skeletal pair. (4) A figure with empty interior is uniquely determined by its skeletal pair. Author (TAB)

N67-24869# Stanford Research Inst., Menlo Park, Calif. Mathematical Sciences Dept.
AN ALGOL CONVOLUTION PROCEDURE BASED ON THE FAST FOURIER TRANSFORM
Richard C. Singleton Jan. 1967 15 p refs
(AD-646628) CFSTI: HC $3.00/MF $0.65

The body of the report was written as a contribution to the Algorithm section of the Communications of the ACM, and consists of three ALGOL procedures with comments. Two fast Fourier transform procedures, FASTFOURIERS and REVERSEFOURIERC, are included because of their use by procedure CONVOLUTION, but can be used independently. Procedure CONVOLUTION computes the convolution of two real vectors A and B of period n. If a noncircular convolution is wanted, the data vectors are extended by adding zeros before computing. The convolution is computed by first transforming A and B to Fourier coefficient vectors alpha and beta forming the complex conjugate product alpha beta, then computing the Fourier transform of alpha beta. The result of the final step is the desired convolution. Computing time for this method increases as n log 2 n, as compared to n2 for the direct method of computing lagged products. Tests show a 10 to 1 time advantage for the transform method at n = 256. TAB

N67-24870# Stanford Univ., Calif. Dept. of Computer Science.
A STOPPING CRITERION FOR POLYNOMIAL ROOT FINDING
Duane A. Adams 10 Feb. 1967 14 p refs
(Contract Nonr-225(37))
(CS-55; AD-647200) CFSTI: HC $3.00/MF $0.65

When solving for the roots of a polynomial, it is generally difficult to know just when to terminate the iteration process. In this paper an algorithm is derived and discussed which allows one to terminate the iteration process on the basis of calculated bounds for the roundoff error. Author (TAB)

N67-24927# Nebraska Univ., Lincoln.
ON THE EXTENSION OF GAUSS–MARKOV THEOREM TO COMPLEX MULTIVARIATE LINEAR MODELS
J. N. Srivastava Wright-Patterson AFB, Ohio, ARL, Sep. 1966 46 p refs
(Contract AF 33(615)-3231)
(ARL-66-0183; AD-647775) CFSTI: HC $3.00/MF $0.65

The purpose of the paper is to develop a (distribution-free) theory of linear estimation under various complex multivariate linear models, which are more general than the usual model to which the standard techniques of multivariate analysis of variance are applicable. In particular, necessary and sufficient conditions under which (unique) best linear unbiased estimates of linear functions of (location) parameters exist are obtained. The extension of the Gauss-Markov Theorem to the standard multivariate model was first made by the author in a previous work. In this paper, the further generalizations of these results to multiresponse designs where the standard model is inapplicable are considered. Author (TAB)

N67-24973# Stanford Univ., Calif. Systems Theory Lab.
ESTIMATION BY THE NEAREST-NEIGHBOR RULE
Thomas M. Cover Sep. 1966 24 p refs
(Contract Nonr-225(83))
(SEL-66-090; TR-7002-1; AD-647045)

The nearest-neighbor estimate of the random parameter associated with a given observation is defined to be the parameter associated with the nearest observation in some training set. This paper is concerned with the infinite parameter problem (estimation) as opposed to the finite parameter problem (classification). Because of the unboundedness of the loss function in the general estimation problem, certain new considerations are required. For a wide range of probability distributions, the large-sample risk of the nearest-neighbor estimate is shown here to be less than twice the Bayes risk for metric loss functions and equal to twice the Bayes risk for squared-error loss functions. In this sense, at least half the information in the training set is contained in the nearest neighbor. Author (TAB)

N67-24974# Stanford Univ., Calif. Systems Theory Lab.
LINEAR RANKINGS OF FINITE-DIMENSIONAL PATTERNS
Thomas M. Cover Sep. 1966 19 p refs
(Contract Nonr-225(83))
(SEL-66-091; TR-7002-2; AD-647046) CFSTI: HC $3.00/MF $0.65

The paper determines Q(n,d), the number of ways that n d-dimensional pattern vectors can be ordered by projection onto a freely-chosen weighting vector. This is equivalent to finding the number of ways of ranking n students on the basis of arbitrary linear combinations of their scores on d examinations. Q (n,d) is independent (subject to minor nonsingularity constraints) of the precise configuration of the pattern vectors, and is naturally expressible as a sum of stirling-like numbers. Author (TAB)

N67-24995# Stanford Univ., Calif. Systems Theory Lab.
BEHAVIOR OF SEQUENTIAL PREDICTORS OF BINARY SEQUENCES
Thomas M. Cover Sep. 1966 21 p refs
(Contract Nonr-225(83))
(SEL-66-092; TR-7002-3; AD-647047) CFSTI: HC $3.00/MF $0.65

The paper concerns the behavior of sequential predictors of finite sequences of 0's and 1's. The question naturally arises as to whether a predictor can achieve high scores on every sequence in some large subset of sequences that are decided a priori to be nonrandom. What prescribed sets of scores may be achieved, and how may they be achieved. What internal consistencies must be present in the set of sequences yielding high scores. This paper is addressed to these questions. TAB

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N67-23481# Air Weather Service, Scott AFB, Ill.
TECHNIQUE DEVELOPMENT REPORTS—1966
Nov. 1966 161 p refs Proc. of the Tech. Develop. Conf., Washington, D. C. May 1966
(TR-188; AD-645118) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. SOME OBJECTIVE ANALYSIS TECHNIQUES SUITABLE FOR NEPHANALYSIS P. Janota p 1–16 refs (See N67-23482 12-20)

2. A COMPUTER TECHNIQUE FOR CONSTRUCTING ISENTROPIC TRAJECTORIES D. R. Greene p 17–25 refs (See N67-23483 12-20)

3. COMPUTER TROPICAL-WIND ANALYSIS A. L. Shumbera, Jr. p 27–35 refs (See N67-23484 12-20)

4. THE AIR WEATHER SERVICE SIX-LEVEL MODEL H. M. O'Neil p 37–41 refs (See N67-23485 12-20)

5. THE DERIVATION OF STRATOSPHERIC DENSITY STATISTICS FROM ROCKET OBSERVATIONS NEAR THE POLES R. S. Quiroz p 43–56 refs (See N67-23486 12-20)

6. WEATHER SUPPORT TO COMPUTER FLIGHT PLANS A. Smith, Jr. and J. R. Irwin p 57–63 (See N67-23487 12-20)

7. PROJECT COLD FOG I R. L. Lininger and H. S. Appleman p 65–70 (See N67-23488 12-20)

8. FINE-MESH LIMITED-AREA FORECASTING MODEL J. G. Howcroft p 71–75 (See N67-23489 12-20)

9. ANALYSIS OF DENSITY DATA DEDUCED FROM LOW-ALTITUDE, HIGH-RESOLUTION SATELLITE TRACKING DATA L. C. Jones (Southern Ill. Univ.), L. L. De Vries, and E. W. Friday p 77–90 refs (See N67-23490 12-20)

10. EXTENDED-RANGE CLOUD FORECASTS J. H. Jones and W. P. Moore p 91–97 refs (See N67-23491 12-20)

11. A TWO-DIMENSIONAL TROPOSPHERIC RAY-TRACKING TECHNIQUE E. S. Harsh p 99–112 refs (See N67-23492 12-20)

12. WEATHER RECONNAISSANCE DATA-REDUCTION PROGRAMS S. L. Williams p 113–123 refs (See N67-23493 12-20)

APPENDIXES

13. GEOPOTENTIAL-ALTITUDE COMPUTATION p 123

14. HORIZONTAL DEGARBLE ROUTINE p 125–126

15. VERTICAL DEGARBLE ROUTINE p 127–129

16. DROPSONDE PRESSURE INTERPOLATION p 131–133 refs

17. NUMERICAL CLOUD PREDICTION H. Edson p 135–143 refs (See N67-23494 12-20)

18. AUTOMATED WEATHER NETWORK J. D. Sharp and L. A. Westphal p 145–154 (See N67-23495 12-20)

N67-23482# Air Weather Service, Scott AFB, Ill.

SOME OBJECTIVE ANALYSIS TECHNIQUES SUITABLE FOR NEPHANALYSIS

Paul Janota *In its* Tech. Develop. Rept.-1966 Nov. 1966 p 1–16 refs (See N67-23481 12-20)

Various objective analysis procedures for meteorological synoptic charting are examined to determine the most suitable for producing cloudcover analyses oriented towards average or most likely objectives with a scale of resolution compatible with the original data. An artificial cloud pattern incorporating many typical features of observed total cloudiness distributions was developed to serve as a common data source. The following analysis techniques were tested: simple average, weighted average, expanding radius of influence, discontinuity preserver, and Barnes technique. Experimental results were obtained and verified against the original synthetic cloud pattern. The test series showed that the best analysis scheme is one which uses data from as few stations as possible and uses only the closest station when bimodality in the influence region is detected. An important qualification to this result is that the grid-point density was higher than the station density in this test. Advantages of the synthetic meteorological situation are that the exact solution is known at each analysis grid point and that data density and the reliability may be manipulated at will. S.P.

N67-23483# Air Weather Service, Scott AFB, Ill.

A COMPUTER TECHNIQUE FOR CONSTRUCTING ISENTROPIC TRAJECTORIES

Douglas R. Greene *In its* Tech. Develop. Rept.-1966 Nov. 1966 p 17–25 refs (See N67-23481 12-20)

A computer technique for constructing isentropic trajectories based on a manual method is developed. This program can construct a great number of trajectories which are computed both forward and backward for any selected potential temperature surface, terminating at almost any point in the northern hemisphere. Tracing the trajectory of a parcel of air is equivalent to tracing the three-dimensional motion of an infinitesimal open system which has no net mass flux across its boundaries. To construct a trajectory by computer techniques all terms are formulated so that they are adaptable to digital methods by use of finite differences and grid analysis fields. For wind calculations an approximation is made by use of the geostrophic wind equation for an isentropic surface. The isentropic trajectory program requires as input a grid-point isentropic stream function analysis at 12-hour intervals. Isentropic trajectories constructed by use of this program are presented along with a discussion of its applications in such fields as the tracing of radioactive air samples. S.P.

N67-23484# Air Weather Service, Scott AFB, Ill.

COMPUTER TROPICAL-WIND ANALYSIS

August L. Shumbera, Jr. *In its* Tech. Develop. Rept.-1966 Nov. 1966 p 27–35 refs (See N67-23481 12-20)

Automation of the global tropical-wind analyses and forecasts is described. The forecast model being developed for the tropical area, when completed, will produce objective analyses and forecasts for nine levels (850 to 100 mb) on a daily operational basis. Briefly, the analysis technique involves wind analysis obtained from three sources: rawins, pibals, and aircraft. Since it is necessary to establish a nondivergent wind field for an intermediate solution of a wind field during the tropical analysis and for input to a tropical-forecast model, stream functions are calculated from the wind analysis. The stream function solution derived by the method described was used in a feedback method of wind analysis. To illustrate the effectiveness of this method in reducing spurious divergence in an analysis, a study was made using the feedback method and one without. The results of the experiment are tabulated. Generally, the 300-mb and 500-mb charts were in good agreement with subjective analyses in areas where data were received. However, in areas of few reports the objective analysis was unable to respond and alter a general climatological first-approximation pattern. Small scale patterns detected cannot be represented by the objective analysis because of the grid size. S.P.

N67-23485# Air Weather Service, Scott AFB, Ill.

THE AIR WEATHER SERVICE SIX-LEVEL MODEL

Hugh M. O'Neil *In its* Tech. Develop. Rept.-1966 Nov. 1966 p 37–41 refs (See N67-23481 12-20)

A six-level quasi-nondivergent model for producing upper-air pressure-height and wind forecasts numerically is described. The six-level model forecasts values for 850, 700, 500, 300, 200, and 100 mb and is similar to the filtered three-level baroclinic model in many respects. Input data are wind and height values at the six specified pressure levels, and the conventional octagonal grid is used to represent each pressure surface. The comprehensive evaluation of a numerical forecast cannot be accomplished by examining a single parameter statistically. However, verification figures for numerical prognoses are customarily given in terms of root-mean-square (RMS) height and vector-wind errors. The RMS values for three levels of the six-level model are tabulated for a series or randomly selected 36-hour prognoses covering the period December 1964 to February 1965 and December 1965. S.P.

N67-23486# Air Weather Service, Scott AFB, Ill.

THE DERIVATION OF STRATOSPHERIC DENSITY STATISTICS FROM ROCKET OBSERVATIONS NEAR THE POLES

Roderick S. Quiroz *In its* Tech. Develop. Rept.-1966 Nov. 1966 p 43–56 refs (See N67-23481 12-20)

The density regime in very high latitudes above radiosonde altitudes was examined in a detailed study of the density field likely to be encountered by a specific reentry vehicle. Observational

data and their accuracies are described, and the problem of combining results from both hemispheres is considered. The relative occurrence of midwinter warmings in the northern and southern hemispheres is examined, since midwinter stratospheric warmings are a measure of the extent to which circumpolar flow is perturbed. Observational data are reported from Heiss Island, McMurdo Sound, and Thule, Greenland. Sampled data consisted of tabulated values of pressure and temperature measured by instruments in the nose cone of a rocket. Other samples consisted of 20 density profiles derived hydrostatically from rocket thermistor data and 3 density profiles from a series of soundings. A total of 47 rocket soundings was used to derive stratospheric density values near the poles. Monthly average densities for 2-km intervals from 30 to 50 km were first derived directly from the observational values of the density. The results are shown for the midseason months and the standard deviation and extreme values in winter and summer. Comparison of the extreme values recorded near 80° latitude with extremes noted earlier at lower latitudes confirms that the lowest hemispheric densities occur near the poles in winter, the highest in summer. S.P.

N67-23487# Air Weather Service, Scott AFB, Ill.
WEATHER SUPPORT TO COMPUTER FLIGHT PLANS
Alonzo Smith, Jr. and Joseph R. Irwin *In its* Develop. Rept.-1966 Nov. 1966 p 57–63 (See N67-23481 12-20)

A semiautomatic computer flight plan system which gives hourly responses to flight-plan demands and is capable of producing 30 flight plans per hour is described. The demand system is designed to operate in several phases using the IBM 7094 and 360 computers in tandem operation. The wind weather forecast tape is the main input to the system. A semiautomatic updating system was developed for integrating selected Military Airlift Command and commericial aircraft reports, upper air data, and high altitude forecasts with the output from the numerical model. Verification of wind-factor reports is discussed as well as plans to improve the accuracy of computer flight plans. S.P.

N67-23488# Air Weather Service, Scott AFB, Ill.
PROJECT COLD FOG I
Ronald L. Liningar and Herbert S. Appleman *In its* Tech. Develop. Rept.-1966 Nov. 1966 p 65–70 (See N67-23481 12-20)

Economical ground-based techniques for dry-ice seeding to dissipate low stratus and fog—Project Cold Fog I—are discussed. Cakes of dry ice were suspended in the fog bank or cloud deck by a line from helium-filled 100-gram pilot balloons. Three modes of balloon launching were used: free, tethered, and towed. The exact locations for balloon placement or release were precomputed using the latest wind information available at test time. A list of test sites, the balloon technique permitted, the weather criteria, and the beginning month of the test program are tabulated. Results of ten cases tested during the 1965–1966 program are presented. After seeding the official visibility was observed to increase in most cases in one to five hours. All tests showed that a knowledge of the test site winds at seeding altitudes is critical for useful positioning of the cleared zone. The seeding effects varied from formation of ice crystals and light to very light snow downwind of the seeding points to zones of improved conditions either near or some miles from the runway. S.P.

N67-23489# Air Weather Service, Scott AFB, Ill.
FINE-MESH LIMITED-AREA FORECASTING MODEL
James G. Howcroft *In its* Tech. Develop. Rept.-1966 Nov. 1966 p 71–75 (See N67-23481 12-20)

Design of an operational numerical weather prediction scheme is described. The fine-mesh limited-area forecasting model will provide higher resolution of atmospheric circulation features to include the scale of nascent cyclone phenomena and depict more accurately, through truncation error control, the motions and developments of the small-scale atmospheric disturbances. The main objective of the fine-mesh model is to obtain higher resolution in short-period forecasts. A six-level quasi-nondivergent model from which sound and gravity waves have been eliminated is used in the program. The fine-mesh program forecasts six levels of stream fields and five of vertical velocity fields. The computer program can produce forecasts over a limited area that can be varied in shape and size, but the size cannot exceed about 1,100 data points. A running time of 18 minutes is required to produce a 36-hour fine-mesh forecast. The program contains an option to print selected maps and/or to write a history tape consisting of stream functions and vertical velocities. S.P.

N67-23490# Air Weather Service, Scott AFB, Ill.
ANALYSIS OF DENSITY DATA DEDUCED FROM LOW-ALTITUDE, HIGH-RESOLUTION SATELLITE TRACKING DATA
L. L. DeVries, E. W. Friday, and L. C. Jones (Southern Illinois Univ.) *In its* Tech. Develop. Rept.-1966 Nov. 1966 p 77–90 refs (See N67-23481 12-20)

Satellite radar-tracking data are analyzed by a technique based on a well-known concept that if only gravitational forces are considered the anomalistic period of a satellite, or equivalently its semimajor axis, is constant and is proportional to the total energy of the satellite. The following density variations have been observed: a diurnal variation, a semiannual variation, variations resulting from changes in electromagnetic solar radiation correlated with the solar decimetric flux, and variations associated with geomagnetic disturbances. The multiple regression analysis and an associated screening procedure were used to derive equations to specify atmospheric density as a function of solar, geomagnetic, and other selected parameters. Analysis of high-resolution density data computed shows two significant density effects which have not been observed in lower-resolution data. These are an apparent longitudinal variation demonstrating maximum density values between about 0° and 30°E longitude and minimum values between 180° and 150°W longitude, and a time lag between geomagnetic activity and atmospheric-density response which is dependent on the latitude of the satellite perigee point. S.P.

N67-23491# Air Weather Service, Scott AFB, Ill.
EXTENDED-RANGE CLOUD FORECASTS
John H. Jones and William F. Moore *In its* Tech. Develop. Rept.-1966 Nov. 1966 p 91–97 refs (See N67-23481 12-20)

The technique for providing daily forecasts of cloud amounts over the northern hemisphere for periods extending up to one week is described. Investigations are directed to relating observed abnormal cloudiness to observed circulation abnormalities at 500 mb. Verification tables are presented in which probability forecasts and the five-day summaries are verified over the forecast area of 351 grid points using clear-sky data. The verification methods used are described. Results indicate that modest success can be achieved in objectively predicting areas of clear sky in daily increments to at least three days in advance. The success of the daily forecast decreases as the prognostic period increases. In general, the verification results encourage the use of systems which consider forecasts from an initial state modified to reflect the deviations of that state from the climatic average. S.P.

N67-23492# Air Weather Service, Scott AFB, Ill.
A TWO-DIMENSIONAL TROPOSPHERIC RAY-TRACING TECHNIQUE
Eugene S. Harsh *In its* Tech. Develop. Rept.-1966 Nov. 1966 p 99–112 refs (See N67-23481 12-20)

A digital-computer technique for preparing ray-tracing diagrams based on geometric optics from observations or forecasts of the

atmospheric refractive index structure is described. In designing this computer program efforts were directed toward providing a data-input format meaningful to the meteorologist and sufficiently flexible to provide ray-traces over all applicable transmitter heights and antenna-elevation angles. Optical properties of microwaves are defined, and the ray-trace equation solution is presented. The computer program produces a series of rays originating over a specified range of initial beam elevation angles. Each ray is traced from some initial beam height out to any specified height and/or distance within the data boundaries. The ray-tracing technique provides an efficient method for producing radar ray-traces based on atmospheric data. To use this program effectively, an x–y plotter must be used for plotting the resulting traces. The refractive index of the atmosphere is defined as the ratio of the propagation velocity of electromagnetic energy in a vacuum to the propagation velocity in the atmosphere. Vertical and horizontal refractive-index gradients are defined as well as the procedures for the conversion of pressure-level data to geometric height. S.P.

N67-23493# Air Weather Service, Scott AFB, Ill.
WEATHER RECONNAISSANCE DATA-REDUCTION PROGRAM
Scott L. Williams *In its* Tech. Develop. Rept.-1966 Nov. 1966 p 113–123 refs (See N67-23481 12-20)

An on-board electronic digital computer and data reduction program for output standard weather-reconnaissance reports are described. The weather elements reported by the automatic systems are the same as if the observations had been taken manually, however, the elements and data-reduction procedures differ. Horizontal data elements are reported as a three-digit decimal number called a system decimal. These system decimals are related to the reported element by transfer equations. Reduction of dropsonde data presents problems not encountered in processing of horizontal data. Some of the difficulties are transmission garbling between dropsonde instrument and aircraft system, the three-digit reporting code, inaccurate knowledge of the thermistor-lag coefficients at high ventilation rates, and inadequate data on lag coefficients of the hygristor used in the dropsonde. Additional data is presented on equations for time-lag correction, grid conversion, geopotential-altitude computation, and horizontal and vertical degarble routines. S.P.

N67-23494# Air Weather Service, Scott AFB, Ill.
NUMERICAL CLOUD PREDICTION
Herbert Edson *In its* Tech. Develop. Rept.-1966 Nov. 1966 p 135–143 refs (See N67-23481 12-20)

A cloud forecasting technique is described that uses a three-dimensional trajectory to advect observed moisture fields in space and time subject to modifications according to known physical laws. This technique produces forecasts of condensation-pressure-spread (CPS) which are converted to cloud amounts through empirical relationships. Two moisture parameters available and analyzed operationally are temperature and dew point. Five to six hundred upper-air soundings are normallly available as input to the analysis program, and initial CPS fields are calculated from temperature-dew-point spread analyses. Layered nephanalyses provide valuable input to the initial moisture analysis. The cloud forecasting model follows individual parcels through the atmosphere for the forecast period and applies physical laws that govern changes to the parcel's state and moisture content. Disadvantages of the technique are that the model neglects the boundary layer; and accuracy of the total-cloud forecast varies with the time of year. A program for evaluation of numerical cloud forecasts based on an arbitrary monthly five-day data sample is described, and future plans are discussed. S.P.

N67-23495# Air Weather Service, Scott AFB, Ill.
AUTOMATED WEATHER NETWORK
John D. Sharp and Louis A. Westphal *In its* Tech. Develop. Rept.-1966 Nov. 1966 p 145–156 (See N67-23481 12-20)

A complex of computer equipment and connecting circuitry known as the Automated Weather Network (AWN) for high-speed weather-data communications is described. The equipment was originally designed to speed the flow of foreign weather data to the U.S. The prime programming objective is that the data be moved in less than five minutes from time of receipt at the first collection and relay center to time of delivery to U.S.A.F. Global Weather Central. A weather editing program is described as well as the system's drum and memory storage capacity. Three major advantages of the AWN are listed as speed, volume or concentration, and complete absence of garbling. Future plans for the system are briefly considered. S.P.

N67-23515# Air Weather Service, Washington, D. C.
TERMINAL FORECAST REFERENCE FILE
1 Oct. 1966 133 p refs
(AD-645300) CFSTI: HC $3.00/MF $0.65

The report gives the general location and topography, weather controls, climatic side local forecast studies for Wright Patterson AFB Ohio. Tables and graphs on climatic data as well as flying conditions for the various months and Maps showing the synoptic weather situations for the seasons are included. Author (TAB)

N67-23856 National Severe Storms Lab., Norman, Okla.
NOTES ON THUNDERSTORM MOTIONS, HEIGHTS, AND CIRCULATIONS
T. W. Harrold, W. T. Roach, and Kenneth E. Wilk Nov. 1966 58 p refs
(NSSL-29; AD-644899) CFSTI: $3.00

CONTENTS:

1. A NOTE ON THE DEVELOPMENT AND MOVEMENT OF STORMS OVER OKLAHOMA ON MAY 27, 1965 T. W. Harrold (Radar Res. and Develop. Estab.) p 1–8 refs (See N67-23857 12-20)

2. MOTION INTENSITY CHARACTERISTICS OF THE SEVERE THUNDERSTORMS OF APRIL 3, 1965 D. E. Wilk p 9–21 refs (See N67-23858 12-20)

3. AN ANALYSIS OF EIGHT FLIGHTS BY U-2 AIRCRAFT OVER SEVERE STORMS IN OKLAHOMA W. T. Roach (British Meteorol. Office) p 23–51 refs (See N67-23859 12-20)

N67-23857# Radar Research and Development Establishment, Malvern (England).
A NOTE ON THE DEVELOPMENT AND MOVEMENT OF STORMS OVER OKLAHOMA ON MAY 27, 1965
T. W. Harrold *In* Natl. Severe Storms Lab. Notes on Thunderstorm Motions, Heights, and Circulations Nov. 1966 p 1–8 refs (See N67-23856 12-20)

Two tornadic storms developed near the Texas–Oklahoma border on May 27, 1965. These storms diverged markedly for several hours, one moving 30° to the right and the other 30° to the left of the mean wind over the cloud depth. A detailed examination of the PPI radar data at 1-min. intervals showed that some individual cells, as well as the larger storm area, were diverging. The Kutta-Joukowski force is considered as a possible factor in the movement, and it is also noted that the movement to the right of the wind could have resulted from continuous propagation toward the moisture supply. The highest storm top, as observed from an aircraft in the vicinity, was higher than that predicted from the parcel theory of convection. This may indicate a significant release of latent heat of fusion within the storm. Author

N67-23858 National Severe Storms Lab., Norman, Okla.
MOTION AND INTENSITY CHARACTERISTICS OF THE SEVERE THUNDERSTORMS OF APRIL 3, 1964
Kenneth E. Wilk *In its* Notes on Thunderstorm Motions, Heights, and Circulations Nov. 1966 p 9–21 refs (See N67-23856 12-20)

Objective techniques are used for analysis of five severe thunderstorms which occurred on April 3, 1964 in Oklahoma and Texas. The radar reflectivities and velocities of the storms are presented and the differences among storms are discussed. The average motion of all storms corresponds to the mean layer wind from the surface to 8 km; however, the range of individual velocities is as large as the mean. Differences in direction of motion rather than speed contribute most to this variability. Although velocities vary from storm to storm, the velocity of the individual storm is conservative and provides a suitable basis for short term forecasting. Probability forecasting by objective extrapolation of individual storm positions is discussed. The variability of the storm motions is viewed with respect to recent theories relating storm translation, rotation, and water budget to the environmental wind.
Author

N67-23859 British Meteorological Office, Bracknell (England).
AN ANALYSIS OF EIGHT FLIGHTS BY U-2 AIRCRAFT OVER SEVERE STORMS IN OKLAHOMA
William T. Roach *In* Natl. Severe Storms Lab. Notes on Thunderstorm Motions, Heights, and Circulations Nov. 1966 p 23–51 refs (See N67-23856 12-20)

The method and results of the analysis of photographic records of the summit areas of severe storms obtained from a U-2 aircraft flying at an altitude of 65,000 ft. over Oklahoma are described. Comparison of the heights of storm cells protruding through the main anvil cirrus deck of a squall line with the predictions of simple "parcel" theory suggests the latter may be used to indicate the maximum development attainable (but not necessarily attained) by a squall line on a given day. It is suggested that temperatures approaching −100°C may occur in the domes of giant quasi-steady storm cells reaching altitudes of 55,000–60,000 ft. Such a dome is probably bounded by a thin shell of extremely stable air, which is not inconsistent with the rather smooth texture of dome summits sometimes shown by the U-2 photographs.
Author

N67-23990 International Antarctic Analysis Center, Melbourne (Australia).
THE SPRINGTIME ACCELERATED WARMING PHENOMENON IN THE ANTARCTIC STRATOSPHERE
H. R. Phillpot Jun. 1964 97 p refs
(TR-3) CFSTI: HC$3.00/MF$0.65

The annual temperature cycle in the Antarctic stratosphere is characterised in spring by a relatively short period during which the temperature rise is very strongly marked although the time and behaviour of the warming process vary considerably from year to year. During the IQSY the International Antarctic Analysis Centre has accepted the responsibility for warning Antarctic stations of the likely occurrence of sudden stratospheric warming periods. The available literature is concerned mainly with observations made during or prior to the IGY, but in this investigation observations up to and including the spring of 1963 have been examined, in particular winter stratospheric temperatures at the South Pole, Byrd and Wilkes stations for limited periods; temperatures at the 100 mb level at all Antarctic stations, and the circulation at the 100 mb. or the 50 mb. level in the spring period of each year 1957 to 1963; a comparison of the temperature distribution across the Antarctic continent in the spring of 1961 and 1962; and finally limited consideration of the ozone observations from Halley Bay during the spring of 1958.
Author

N67-23991 Bureau of Meteorology, Melbourne (Australia).
UPPER WIND STATISTICS, AUSTRALIA, SURFACE TO 55,000 FT., JUNE 1957–MAY 1961
J. V. Maher and J. N. McRae May 1964 131 p refs
CFSTI: HC$3.00

A comprehensive description of the upper atmospheric winds over Australia is presented. Estimates of a series of basic parameters of the wind distribution at various levels to 55,000 ft were tabulated for some 23 stations and form the basic statistics of the upper wind distribution. Details of the station network, observation times, observing equipment, basic statistics, and some general statistical theory relevant to upper wind distributions are given.
R.N.A.

N67-24005# Weather Wing (1st), San Francisco, Calif. 96525
MID-LATITUDE FRONTAL CLOUD MODELS
George Taniguchi Jan. 1967 26 p refs *Its* Tech. Study 7
(AD-646031) CFSTI: HC$3.00/MF$0.65

This study presents typical cloud patterns associated with mid-latitude weather systems. These models can be used as a guide when preparing prognostic HWD charts or making flight forecasts. The study also illustrates how forecasters can extract valuable information from APT satellite pictures, etc. Part I gives a series of cloud patterns associated with fronts and vortices. Part II is a case study of cloud patterns associated with a Shanghai Low.
TAB

N67-24053# Weather Wing (1st), San Francisco, Calif. 96525
A PRELIMINARY ESTIMATE OF EXTREME WIND SPEEDS IN THAILAND Technical Study No. 3
Gary D. Atkinson Oct. 1966 31 p refs
(AD-645089) CFSTI: HC$3.00/MF$0.65

Estimates of extreme wind speeds for various cumulative probabilities or return periods are made for 13 Thailand stations using the double-exponential distribution Annual Peak wind gusts for a 10 year period, 1956-1965, are used in the analysis. Comparison of expected peak gusts are made between stations and with stations in the interior United States. Seasonal and monthly differences in expected peak gusts are discussed. Correction factors for elevation differences and conversion factors to determine sustained winds are presented. Also given are the directions and occurrence times of extreme winds.
Author (TAB)

N67-24054# Weather Wing (1st), San Francisco, Calif. 96525
OBJECTIVE METHOD TO FORECAST LOW MORNING VISIBILITIES AT UBON, THAILAND, JANUARY–MARCH Technical Study No. 4
Nov. 1966 14 p
(AD-645090) CFSTI: HC$3.00/MF$0.65

An objective method is derived to forecast occurrence of surface visibilities less than 5 miles caused by ground fog, haze and/or smoke at Ubon, Thailand from 1 January to 15 March.
Author (TAB)

N67-24055# Weather Wing (1st), San Francisco, Calif. 96525
FORECASTING LOW LEVEL TURBULENCE FOR LIGHT AIRCRAFT Technical Study No. 5
Charles A. Bihler Nov. 1966 10 p
(AD-645091) CFSTI: HC$3.00/MF$0.65

The study describes a semi-objective method for forecasting low level turbulence for light aircraft operation, designed primarily for use in Korea. Maximum surface or gradient level wind speeds and low level stability are used as predictors. The method can be applied in any area where mechanical turbulence due to rough terrain occurs.
Author (TAB)

N67-24283# National Center for Atmospheric Research, Boulder, Colo.
SATELLITE DATA IN METEOROLOGICAL RESEARCH
Henry M. E. van de Boogaard Dec. 1966 358 p refs Proc. of a Workshop held in Boulder, Colo., 25–31 Aug. 1965
(NCAR-TN-11) CFSTI: HC$3.00/MF$0.65

Techniques for using satellite data were discussed, with emphasis focused on tropical and severe local storms; local and general circulation; water vapor, temperature structure, and heat budget; and radiation physics. For individual titles, see N67-24284 through N67-24309.

N67-24284# National Center for Atmospheric Research, Boulder, Colo.
SATELLITE METEOROLOGY AND THE ACADEMIC COMMUNITY
W. W. Kellog *In its* Satellite Data in Meteorol. Res. Dec. 1966 p 5–13 (See N67-24283 12-20)

The progression of meteorological satellite technology is traced from its conceptual origin and early implementation to its promise for the future. The apparent apathy of both research meteorologists and operational forecasters to the advantages of satellite meteorology is pointed out, and an attempt is made to answer two basic questions: (1) What have been the problems in the past that have hindered the use of meteorological satellite data and (2) What does the future hold for meteorological satellites?
A.G.O.

N67-24285# Air Force Cambridge Research Labs., Bedford, Mass.
TECHNICAL ASPECTS OF METEOROLOGICAL SATELLITE PHOTOGRAPHY
John H. Conover *In* Natl. Center for Atmospheric Res. Satellite Data in Meteorol. Res. Dec. 1966 p 15–32 refs (See N67-24283 12-20)

Cloud photography from the Tiros system is used to demonstrate the technical aspects of meteorological satellite photograph interpretation. The classification of clouds in terms of their form, pattern, texture, brightness, and dimensions of patterns and forms is discussed, and an organization chart which is used to synthesize these characteristics is presented. Consideration is also given to the computation of albedos from Tiros photography.
A.G.O.

N67-24286# National Weather Satellite Center, Washington, D. C.
USE OF SATELLITE DATA IN THE TROPICS
Lester F. Hubert *In* Natl. Center for Atmospheric Res. Satellite Data in Meteorol. Res. Dec. 1966 p 35–48 refs (See N67-24283 12-20)

The applications of satellite data in connection with tropical storms and tropical analysis are illustrated. It is reported that satellite pictures show a hierarchy of patterns that exist as a storm develops from a minor wave or disturbance. As the storm progresses up to maximum intensity, the cloud pattern evolves through a detectable sequence. These data raise questions concerning the development of a model of tropical storm genesis to provide a basis for operational estimates.
A.G.O.

N67-24287# Colorado State Univ., Fort Collins.
SOME PROBLEMS IN THE USE OF SATELLITE DATA
Herbert Riehl *In* Natl. Center for Atmospheric Res. Satellite Data in Meteorol. Res. Dec. 1966 p 49–50 (See N67-24283 12-20)

Equipment and personnel problems involved with the application of observational data to specific weather programs are pointed out. The development of a centralized agency for data processing is suggested as the inevitable answer for making meteorological research practical to smaller groups and institutions.
A.G.O.

N67-24288# Colorado State Univ., Fort Collins.
COMPUTER PROGRAM
W. Kamm *In* Natl. Center for Atmospheric Res. Satellite Data in Meteorol. Res. Dec. 1966 p 51–52 refs (See N67-24283 12-20)

The development of a computer program to extract specific data from binary tapes of Tiros III, IV, and VII channel 2 (8 to 12 micron) radiation data is briefly described. The object of the computer program is to enable the extraction of required data for any orbit and any particular geographic region. The main problem encountered was that of coping with the three types of scanning modes (single open, closed, and alternating open) of the satellite.
A.G.O.

N67-24289# Chicago Univ., Ill.
USE OF SATELLITE DATA IN MESOMETEOROLOGY
Tetsuya Fujita *In* Natl. Center for Atmospheric Res. Satellite Data in Meteorol. Res. Dec. 1966 p 55–77 (See N67-24283 12-20)

Radiation and photographic analyses results are presented which have potential value in the study of severe storms. The combined analysis of satellite photographs and radar echoes is considered, and the need for radiation data in obtaining vertical resolution is pointed out. The radiation pattern analysis of Hurricane Anna in 1961 is discussed, and the dust storms associated with the Palm Sunday tornadoes, 1963, are mentioned. Basic problems in determining cloud covers and emissivity from radiation data are also examined.
A.G.O.

N67-24290# National Severe Storms Lab., Norman, Okla.
USE OF SATELLITE DATA IN SEVERE THUNDERSTORM RESEARCH
Leslie D. Sanders *In* Natl. Center for Atmospheric Res. Satellite Data in Meteorol. Res. Dec. 1966 p 79–81 (See N67-24283 12-20)

The potentialities of satellite data applications in severe storm research are considered. The problem of how to use initial data to provide information that is not available by any other means is analyzed, and the question of the detection of air flow through clouds and cloud patterns is examined. Pertinent topics of interest to the severe storms forecasters such as the depth and structure of the maritime tropical air moist layer and the precise location of dry fronts are also discussed.
A.G.O.

N67-24291# Weather Bureau, Washington, D. C.
THE USE OF SATELLITE DATA IN WEATHER ANALYSIS
Vincent J. Oliver and Edward W. Ferguson *In* Natl. Center for Atmospheric Res. Satellite Data in Meteorol. Res. Dec. 1966 p 85–101 refs (See N67-24283 12-20)

Presented is a discussion of proposed uses of satellite data in weather analysis which focuses on the use of operational meteorological satellites for locating fronts and storm centers; and observing cloud patterns associated with secondary vorticity centers, jetstreams, and midtropospheric trough and ridge lines. Emphasized is the importance of satellite observations of secondary vorticity centers; and the usefulness of satellite data in making possible more accurate machine and hand analyses thus improving the accuracy of forecasts. It is surmised that satellite data on cloud patterns associated with secondary vorticity centers, jetstreams, and midtropospheric trough and ridge lines may be more important primarily because they are more directly the circulation features used by the computer, and secondarily because these features are more frequently missed entirely or poorly located both by computer techniques and by hand analysis. It is further surmised that the secondary vorticity center cloudiness will be the most useful of all of the observations in improving middle latitude forecasting ability.
S.C.W.

N67-24292# Massachusetts Inst. of Tech., Cambridge.
LARGE-SCALE CLOUD SYSTEMS
Frederick Sanders *In* Natl. Center for Atmospheric Res. Satellite Data in Meteorol. Res. Dec. 1966 p 103–120 refs (See N67-24283 12-20)

Analyzed is a program designed to obtain an insight into the production and maintenance of large-scale cloud systems, to enhance the diagnostic value of Tiros cloud photography by calculating large-scale vertical motions, and to compare some of the results with the cloud photographs. The study focuses on: (1) the relative importance of the roles of horizontal and vertical motion in accounting for the observed configuration of cloud systems; and (2) the degree to which the presence or absence of cloud can be taken as an indication of local ascent or subsidence. The approach used in an attempt to answer these questions is a study of the relationships between fields of large-scale vertical motion and cloud patterns observed by satellite for selected cases in middle latitudes. The criteria for selection of cases were the clear-cut synoptic characters of both continental and maritime environments subject to limitations imposed by availability of both upper-level sounding data and Tiros observations. The method of analysis used in these studies is discussed, and a case which illustrates the formation and evolution of a spectacular long-lived vortex, associated with an occluding, weak surface system; is analyzed. S.C.W.

N67-24293# Freie Univ., Berlin (West Germany). Inst. fuer Meteorologie und Geophysik.
SYNOPTIC APPLICATIONS OF SATTELLITE-BORNE INFRARED WINDOW MEASUREMENTS
Guenter Warnecke *In* Natl. Center for Atmospheric Res. Satellite Data in Meteorol. Res. Dec. 1966 p 121–131 (See N67-24283 12-20)

Brief comments are presented on the potentiality of satellite radiation data for synoptic analysis. Discussed is the 8 to 12 μ band equivalent blackbody temperature analysis over the United States for July 1961 as obtained from the Tiros III satellite. On the basis of derived results and an analysis of existing literature, it is concluded that the 8 to 12 μ radiation band will generally provide the gross pattern of cloudiness rather than details; and that details may be derived where there are restricted areas of homogeneous dense cloud decks filling the field of view of the radiometer. Also emphasized is the potentiality of this type of information, if it is available, on a quasi-global (in the case of Tiros) or a global scale (in the case of the Nimbus satellite) particularly over areas where no weather information is available. It is speculated that using this information, one can infer the gross features of the horizontal and vertical cloud distributions and thus locate significant weather systems such as cyclones and fronts. It is emphasized that satellite measurement of terrestrial infrared radiation has a high potential of information for synoptic purposes; and once available on an operational basis, it should become an extremely useful and indispensible tool for synoptic meteorologists. S.C.W.

N67-24294# Weather Bureau, Washington, D. C.
LOCAL CIRCULATIONS AS SEEN FROM SATELLITE CLOUD PICTURES
Sigmund Fritz *In* Natl. Center for Atmospheric Res. Satellite Data in Meteorol. Res. Dec. 1966 p 135–162 refs (See N67-24283 12-20)

Presented is a discussion of the following types of local circulation patterns observed in satellite cloud pictures: the so-called cellular pattern, the mountain wave pattern, and spiral cloud patterns seen in the lee of certain islands. S.C.W.

N67-24295# Colorado State Univ., Fort Collins.
OROGRAPHIC EFFECTS AND JET STREAM STRUCTURE
Elmar R. Reiter *In* Natl. Center for Atmospheric Res. Satellite Data in Meteorol. Res. Dec. 1966 p 163–170 refs See N67-24283 12-20)

Summarized are results of studies of the energy spectra of atmospheric turbulence which include preliminary data on atmospheric meso- and microstructure and clean air turbulence; and the mesostructure of subtropical jet stream flow. S.C.W.

N67-24296# National Center for Atmospheric Research, Boulder, Colo.
INTRODUCTION, GENERAL CIRCULATION
Philip D. Thompson *In its* Satellite Data in Meteorol. Res. Dec. 1966 p 173–174 (See N67-24283 12-20)

Introductory remarks on the usefulness of meteorological satellite observations in studies of general circulation problems are presented. Emphasized are questions relating to what conventional satellite measurements do not reveal, as for example, the heat balance which is an all important factor in the general circulation problem; and the transfer of heat by convection, notably in the tropical regions. Limitations of satellite observations which result in inaccurate pictures of the intervening scale are briefly noted. S.C.W.

N67-24297# Wisconsin Univ., Madison.
GENERAL CIRCULATION
V. Suomi *In* Natl. Center for Atmospheric Res. Satellite Data in Meteorol. Res. Dec. 1966 p 175–188 refs (See N67-24283 12-20)

A discussion of satellite measured variations of radiational balance in the earth's atmosphere is presented which emphasizes differences between latitudinal, longitudinal, and time variations of incoming short-wave radiation and outgoing long-wave radiation. S.C.W.

N67-24298# Weather Bureau, Washington, D. C. Meteorological Satellite Lab.
RADIATIVE HEATING
Jay S. Winston *In* Natl. Center for Atmospheric Res. Satellite Data in Meteorol. Res. Dec. 1966 p 189–196 refs (See N67-24283 12-20)

Data on the variations of radiation with large-scale circulation and the possible feedback of this heating on the circulation is presented. Latitudinal distributions of the albedo and long-wave radiation from Tiros IV measurements were examined in relation to the large-scale flow pattern over the Pacific Ocean area, and differences in latitudinal profiles of short-wave and long-wave radiation were found for differing states of the circulation pattern. Data indicate that varying cloud distributions associated with variations in the flow patterns can have some significant influence on the generation of zonal available potential energy and therefore affect future developments of the circulation pattern. An experiment was devised utilizing a series of variable profiles in the Mark I numerical generation model of Smagorinsky. Examined was the quantitative influence of heating variations on the circulation. Results suggest that the differing distributions of cloudiness which accompany various circulation states may have substantial feedback on the future states of the circulation through their influence on the basic energy source for the general circulation; and that these effects would be of importance for periods of several weeks and possibly longer periods. S.C.W.

N67-24299# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SATELLITE RADIATION MEASUREMENTS IN SPECTRAL REGIONS
William Nordberg *In* Natl. Center for Atmospheric Res. Satellite Data in Meteorol. Res. Dec. 1966 p 199–213 (See N67-24283 12-20)

Presented is a description of the methods by which stratospheric temperatures were derived from Tiros VII radiance measurements of carbon dioxide bands between 14.5 and 15.2 μ. Discussed are limitations inherent in the method, namely, poor signal-to-noise ratios and poor accuracy resulting from transparency of the interference filter used to determine the radiometer's spectral response, and the percentage of random error in individual points and weekly averages of stratospheric measurements. The meteorological significance of worldwide weekly averages of stratospheric temperatures assumed to be stable over periods of a few days is also discussed. It is pointed out that the significance of taking weekly averages is that within one week sufficiently dense coverage within grid elements of 2.5 to 2.5° can be obtained over the entire quasi-globe, and that any temperature differences which show up in these averages will be meteorologically significant rather than just random errors. S.C.W.

N67-24300# Freie Univ., Berlin (West Germany). Inst. fuer Meteorologie und Geophysik.

TIROS VII, 15μ RADIOMETRIC MEASUREMENTS AND MID-STRATOSPHERIC TEMPERATURE

Gunter Warnecke *In* Natl. Center for Atmospheric Res. Satellite Data in Meteorol. Res. Dec. 1966 p 215–227 (See N67-24283 12-20)

The potentiality of satellite-borne radiometer measurements in the 15μ carbon dioxide emission band for synoptic representation of temperature patterns in the stratosphere is discussed. Analyzed are data from a global temperature analysis at the 30-mb pressure surface. Computations of the general pattern of mid-stratospheric temperature distribution in the northern and southern hemispheres are derived. The high correlation coefficients obtained in both cases indicate that one can interpret the satellite remote-sensing radiation measurements of the 15μ band as an equivalent of the 30-mb temperature field. In view of this, application of remote sensing temperatures at constant pressure surfaces is recommended. Details of the changes with respect to time of stratospheric temperature changes observed by the satellite are also analyzed. On the basis of case studies, it is concluded that the satellite-borne radiometer measurements in the 15μ carbon dioxide emission band have a very high potentiality for synoptic surveys of the temporal and spatial thermal behavior of the middle stratosphere. It is further surmised that whereas the lack of conventional radiosonde measurements over strategic regions made it impossible to detect the areas of origin of the stratospheric warmings, the satellite measurements seem to indicate that these may be found somewhere in the subtropics or even the tropics proper. S.C.W.

N67-24301# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ATMOSPHERIC WATER VAPOR CONTENT FROM SATELLITE RADIATION MEASUREMENTS

William R. Bandeen *In* Natl. Center for Atmospheric Res. Satellite Data in Meteorol. Res. Dec. 1966 p 229–249 refs (See N67-24283 12-20)

Presented is a description of methods used to infer atmospheric water vapor content from Tiros II, III, and IV satellite radiometer measurements in the 6.3μ absorption band, and in the 8 to 12μ atmospheric window. Emphasized is the use of Moller's method and a Moller-type evaluation diagram for deriving the mean relative humidity of the atmosphere. Included is a synoptic study of equivalent black body temperature measurements by the window channel of Tiros III. Analyzed are the relative humidities derived from satellite data using the proposed elevation diagram, and conventional analyses of relative humidity at 400-mb, and between 1000 and 500-mb. Data were in good agreement. Good agreement was also obtained from large-scale correlations between vertical motion (at 650-mb) and relative humidity. Also evaluated are results of global studies of water vapor distribution. Discussed are the techniques by which total water vapor mass above 500-mb is inferred, and results of a comparative study of the satellite analysis on a global scale and a conventional analysis by Bannon and Steele (1960). S.C.W.

N67-24302# Weather Bureau, Washington, D. C.

RADIOMETER DATA IN THE 15μ BAND

Sidney Teweles *In* Natl. Center for Atmospheric Res. Satellite Data in Meteorol. Res. Dec. 1966 p 251–257 (See N67-24283 12-20)

A discussion of how temperatures measured by the Tiros VII 15μ band radiometer compare with those obtained from conventional radiosonde data is presented which focuses on the aspects of how temperature fluctuations match up, and the satellite's capability to follow systems; is presented. Two case studies representing the southern hemisphere are reviewed. Compared are data from Campbell Island in the vicinity of New Zealand, and Wilkes Station on Antarctica. Results from these studies show that the satellite measurements obtained by the 15μ band radiometer are capable of detecting the stratospheric temperature oscillations and also of following their progress time and space. Several points which were noted while using satellite data and which serve to caution the analyst are listed under several primary headings which emphasize the properties of a radiation derived layer mean temperature; the essence of full orbit interrogation capability; the advantages of satellite measurements of stratospheric temperatures; the advantages of the Nimbus satellite system; and the optimum application of data. S.C.W.

N67-24303# Geophysics Corp. of America, Bedford, Mass.

RADIATION PHYSICS

Jean I. F. King *In* Natl. Center for Atmospheric Res. Satellite Data in Meteorol. Res. Dec. 1966 p 261–278 refs (See N67-24283 12-20)

Methods used to derive inferences concerning the vertical thermal structure of the atmosphere from satellite remote radiation soundings are analyzed. Emphasized are the advantages and limitations of a refinement of a linear technique and nonlinear method. An algorithm method for inferring the temperature-pressure profile is described. It is shown that the advantages of the method are that: (1) the data generate a unique polynomial set, (2) it has a rationale for determining the channels, and (3) it is insensitive to noise. Case histories which demonstrate the applicability of the proposed inversion method are cited. On the basis of data from case history analyses, it is concluded that inversion is possible and that it should be performed routinely once the Nimbus-C satellite with its multi-channel radiometer is in orbit. It is also concluded that it will be possible by this method to infer flux divergences and, in principle, one can infer anything that is coupled with the radiation field. S.C.W.

N67-24304# National Weather Satellite Center, Washington, D. C.

INVERSION PROBLEMS

David Wark *In* Natl. Center for Atmospheric Res. Satellite Data in Meteorol. Res. Dec. 1966 p 279–292 (See N67-24283 12-20)

Limitations of numerical methods used in solving for the unknown Planck radiance and instrumentation measurements of atmospheric radiance and absorption are discussed in view of their significance to solutions of inversion problems. S.C.W.

N67-24305# Colorado Univ., Denver.

PROBLEMS RELATED TO THE USE OF SATELLITE OBSERVATIONS

Julius London *In* Natl. Center for Atmospheric Res. Satellite Data in Meteorol. Res. Dec. 1966 p 293–297 (See N67-24283 12-20)

Problems in the use of satellite information which are related to (1) the development of the ability to discriminate between aerosol layers and cirrus clouds in the upper troposphere and lower stratosphere, (2) understanding the different emission properties of these radiating sources, and (3) the applicability of radiative transfer theory are discussed. S.C.W.

N67-24308# Weather Bureau, Washington, D. C. Meteorological Satellite Lab.
THE WEATHER BUREAU AND THE SATELLITE PROGRAM
David S. Johnson *In* Natl. Center for Atmospheric Res. Satellite Data in Meteorol. Res. Dec. 1966 p 325–332 ref (See N67-24283 12-20)

Research and development efforts of the Weather Bureau's Meteorological Satellite Program are discussed. Reviewed are major program objectives of the National Weather Satellite Center; meteorological satellites which are still in operation; and related studies by NASA which will improve the Tiros Operational Satellite (TOS) system. Also discussed briefly is the availability of satellite data for research and the availability of training material for use in course work. S.C.W.

N67-24368# Weather Wing (1st), San Francisco, Calif. 96525
A PRACTICAL APPROACH TO STREAMLINE ANALYSIS
Patrick E. Pickett Feb. 1967 28 p refs *Its* Tech. Study 9
(AD-647595) CFSTI: HC$3.00/MF$0.65

The study is a revision of a paper originally prepared by Capt Pickett during his tour in Southeast Asia during 1964-1965. It presents several basic fundamentals and practical exercises of streamline analysis. The study is designed as a training aid for meteorologists with little or no experience or training in tropical meteorology. Author (TAB)

N67-24771# Stanford Research Inst., Menlo Park, Calif.
LIDAR-RADAR LOWER ATMOSPHERIC OBSERVATIONS Final Report, 1 Apr.–14 Nov. 1966
William Viezee and John Oblanas 14 Dec. 1966 65 p refs
(Contract AF 19(628)-5976)
(AFCRL-67-0013; AD-647463) CFSTI: HC$3.00/MF$0.65

Simultaneous observations of the lower atmosphere with lidar (laser radar) and microwave radar are summarized. The observations are restricted in space to the location of Stanford Research Institute, Menlo Park, California, and in time to June, August, and September 1966. Lidar echoes from the clear lower atmosphere are compared with the temperature and humidity data from the rawinsonde ascents made at Oakland, California. During clear skies, no radar or lidar echoes were observed above 20.00 m. Below this level the atmospheric structure that was analyzed from the lidar data showed a diurnal variation similar to that of the thermal stability of the atmosphere. Other time-dependent variations that were evident in the data are believed to be related to short period changes in the height of the top of the marine layer. No specific relationship was found between the lidar data and the rawinsonde data from Oakland. Radar echoes observed in the clear lower atmosphere were classified as meteorological angles. Author (TAB)

N67-24780# Indatacon Corp., Bolton, Mass.
ADDITION OF SIGNAL CONDITIONING AND DATA PROCESSING CAPABILITY TO THE UNATTENDED METEOR TRAIL WIND AND DENSITY SET Final Report, Sep. 1964–Feb. 1966
William H. Ramsey Feb. 1966 26 p ref
(Contract AF 19(628)-4307)
(AFCRL-66-438; AD-646668) CFSTI: HC$3.00/MF$0.65

The document contains an overall description of the system and includes operating parameters, etc. The theoretical accuracies in determining slant range, elevation angle, altitude, wind velocity and density by photographic recording and digital computation are described. The experimental accuracies achieved for these quantities are also discussed and a comparison is made. Author (TAB)

N67-24920# American Meteorological Society, Boston, Mass.
NUMERICAL INTERPRETATION OF CLOUD INFORMATION FROM METEOROLOGICAL SATELLITES [O CHISLENNOI INTERPRETATSII INFORMATSII OB OBLACHNOSTI, POST-UPAIUSHCHEI S METEOROLOGICHESKIKH SPUTNIKOV]
Sh. A. Musaelian and A. Z. Chekirda Bedford, Mass., AFCRL, Oct. 1966 19 p ref Transl. into ENGLISH from Gl. Geofiz. Observ. (Leningrad), no. 166, 1964 p 189–202
(Contract AF 19(628)-3880)
(TR-468; AD-646617) CFSTI: HC$3.00/MF$0.65

Determination of the cloud field from the vertical motion field is a problem of long standing, and now we are concerned with the opposite problem, determination of the vertical motion field from the cloud field. This new problem has arisen in connection with meteorological satellites which provide information, basically, on radiation characteristics and on the state of the earth's cloud cover. This information must be employed operationally and with maximum efficiency by meteorologists. The structure and dimensions of various cloud formations and their inherent characteristic features in various synoptic situations may be established on the basis of satellite photographs of cloud systems. It is especially important to obtain such information from regions where meteorological observations are rarely made. Many meteorologists are concerned with synoptic interpretation of information on cloud systems. This interpretation, in final analysis, amounts to a visual study of the cloud field and the introduction of corrections (sometimes quite substantial) into the surface chart, especially for regions where surface information is scanty or entirely lacking. Numerical forecasting requires a quantitative interpretation of cloud information, not a qualitative synoptic interpretation. In the present paper we propose a method of determining the vertical motion field from the cloud distribution. TAB

N67-25006*# National Aeronautics and Space Administration, Washington, D. C.
SPACE METEOROLOGY: A STORY ABOUT THE ARTIFICIAL EARTH SATELLITE "COSMOS-144"
G. Golyshev and I. Andronov Mar. 1967 8 p Transl. into ENGLISH of the book "Kosmicheskaya Meteorologiya" USSR, Izv., No. 64, 17 Mar. 1967 5 p
(NASA-TT-F-10855) CFSTI: HC$3.00/MF$0.65

Five years ago, the first artificial earth satellite of the "Cosmos" series was placed in orbit. Since that time, satellites of this series have been launched regularly. Their number is already approaching 150. "Cosmos" satellites have made an important contribution to the study of outer space, helped discover the picture of a number of physical processes which occur in the sun, and provide new and important information of distant objects of the universe. But, in addition to great scientific significance, their launchings are beginning to acquire a vital national economic value. A story is reported about one of the satellites of the series—"Cosmos-144", which was intended for the collection of meteorological information and its transmission to earth. Author

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N67-23713*# Honeywell, Inc., Minneapolis, Minn.
DERIVATION AND STATISTICAL COMPARISON OF VARIOUS ANALYTICAL TECHNIQUES WHICH DEFINE THE LOCATION OF REFERENCE HORIZONS IN THE EARTH'S HORIZON RADIANCE PROFILE
John R. Thomas Washington, NASA, Apr. 1967 155 p refs
(Contract NAS1-6010)
(NASA-CR-726) CFSTI: HC$3.00/MF$0.65 CSCL 17G

The accuracy of horizon sensors which provide for a vertical reference in space control systems has been the subject of numerous investigations in the past few years; however, these errors due to the effects of horizon anomalies have not been completely defined or verified. This study focused attention on these errors, their frequency, and distribution for a large number of detection techniques. To use a horizon scanner in determining an artificial Earth horizon, some function of the radiant energy received is used to define this horizon. This function is defined as a locator. Thirty locators were identified based on the radiance profile shape and amplitude and were mathematically defined for programming on a digital computer. Using 1039 synthesized radiance profiles, each of these locators was processed and the resultant indicated altitudes statistically analyzed. This statistical comparison, using those locators which approximate the operation of horizon sensors, yields results applicable to horizon sensing accuracy. The most stable horizon calculated, over the sample of the 1039 radiance profiles, was obtained using fixed thresholds of the integral of normalized radiance. For that locator and present component state-of-the-art, the mean located horizon altitude is 44.0 km with a standard deviation of only 1.1 km, producing an angular uncertainty in horizon location of ±0.034 degrees from a 280 km (150 nautical mile) viewing altitude. Author

N67-23801# European Space Research Organization, Paris (France).
SPACECRAFT TECHNOLOGY. VOL. II: CONTROL AND STABILISATION
Jul. 1966 317 p refs Proc. of the 2d ESRO Summer School, Oxford, 1964
(ESRO-SP-10) CFSTI: HC$3.00/MF$0.65

CONTENTS:

1. ATTITUDE CONTROL: INTRODUCTORY LECTURE W. G. Hughes (Royal Aircraft Estab.) 10 p (See N67-23802 12-21)

2. ATTITUDE CONTROL NOTATION, AXIS SYSTEMS, TRANSFORMATIONS, AND RIGID BODY DYNAMICS W. G. Hughes (Royal Aircraft Estab.) 35 p refs (See N67-23803 12-21)

3. ATTITUDE CONTROL: ENVIRONMENTAL TORQUES ON A SATELLITE W. G. Hughes (Royal Aircraft Estab.) 15 p refs (See N67-23804 12-21)

4. MASS EJECTION SYSTEMS FOR ATTITUDE CONTROL B. P. Day (Royal Aircraft Estab.) 52 p refs (See N67-23805 12-21)

5. ATTITUDE CONTROL: MAGNETIC CONTROL ACTUATORS W. G. Hughes (Royal Aircraft Estab.) 6 p refs (See N67-23806 12-21)

6. ATTITUDE CONTROL: MOMENTUM EXCHANGE CONTROL ACTUATORS W. G. Hughes (Royal Aircraft Estab.) 14 p refs (See N67-23807 12-21)

7. ATTITUDE CONTROL: GYROS AS SENSORS W. G. Hughes (Royal Aircraft Estab.) 8 p ref (See N67-23808 12-21)

8. ATTITUDE CONTROL: ATTITUDE SENSORS M. B. Barnes and G. W. Brown (Royal Aircraft Estab.) 34 p refs (See N67-23809 12-21)

9. ATTITUDE CONTROL: SPIN STABILISATION W. G. Hughes (Royal Aircraft Estab.) 15 p refs (See N67-23810 12-21)

10. PASSIVE AND SEMI-PASSIVE ATTITUDE CONTROL OF AN EARTH-POINTING SATELLITE N. E. Ives (Royal Aircraft Estab.) 17 p refs (See N67-23811 12-21)

11. ATTITUDE CONTROL BY PURE JET SYSTEMS K. J. O'Mahony (Royal Aircraft Estab.) 27 p refs (See N67-23812 12-21)

12. ATTITUDE CONTROL: REACTION WHEEL CONTROL SYSTEMS W. G. Hughes (Royal Aircraft Estab.) 19 p refs (See N67-23813 12-21)

13. ATTITUDE CONTROL: JET AND MAGNETIC UNLOADING SYSTEMS W. G. Hughes (Royal Aircraft Estab.) 8 p refs (See N67-23814 12-21)

14. ATTITUDE CONTROL OF STELLAR OBSERVATORY SATELLITES W. G. Hughes (Royal Aircraft Estab.) 17 p refs (See N67-23815 12-21)

15. ATTITUDE CONTROL OF COMMUNICATION SATELLITES J. K. Abbott (Royal Aircraft Estab.) 12 p refs (See N67-23816 12-21)

16. ATTITUDE CONTROL SYSTEMS FOR THE MARINER, OSO AND OGO SATELLITES W. G. Hughes (Royal Aircraft Estab.) 8 p (See N67-23817 12-21)

N67-23802# Royal Aircraft Establishment, Farnborough (England).
ATTITUDE CONTROL: INTRODUCTORY LECTURE
W. G. Hughes *In* ESRO Spacecraft Technol. Vol. II 10 p (See N67-23801 12-21)

The requirements for pointing satellite apparatus for primary and supporting activities, and the types of control are reviewed. The attitude control systems are indicated as being: active control relative to a directional reference; active inertial control; passive control relative to a directional reference; and passive inertial control. The control actuation methods are covered, and the organization of the lecture course is outlined. N.E.N.

N67-23803# Royal Aircraft Establishment, Farnborough (England).
ATTITUDE CONTROL NOTATION, AXIS SYSTEMS, TRANSFORMATIONS, AND RIGID BODY DYNAMICS
W. G. Hughes *In* ESRO Spacecraft Technol. Vol. II Jul. 1966 35 p refs (See N67-23801 12-21)

Rigid body kinematics and dynamics are discussed in relation to satellite attitude control problems. Questions of systems of axes, axis transformations, and angular velocities are considered, attention being given to ways of expressing axis transformations in forms suitable for computation. Equations of motion are developed for systems of pivoted rigid bodies, with discussion of the simplifications which can often be used. The free motion of a rigid body is then treated and finally equations are developed for small displacements of a rigid body relative to an earth-pointing axis system. Author (ESRO)

N67-23804# Royal Aircraft Establishment, Farnborough (England).
ATTITUDE CONTROL: ENVIRONMENTAL TORQUES ON A SATELLITE
W. G. Hughes *In* ESRO Spacecraft Technol. Vol. II Jul. 1966 15 p refs (See N67-23801 12-21)

The torques which a satellite will experience due to the principal environmental disturbances are discussed; these are the earth's atmosphere, the earth's gravitational field, the earth's magnetic field, solar radiation pressure, and meteoroid impact. Author (ESRO)

N67-23805# Royal Aircraft Establishment, Farnborough (England).
MASS EJECTION SYSTEMS FOR ATTITUDE CONTROL
B. P. Day *In* ESRO Spacecraft Technol. Vol. II Jul. 1966 52 p refs (See N67-23801 12-21)

Some of the many different types of low-thrust mass-ejection systems which have been proposed for use in space are

summarized, and an elementary approach to the selection of a suitable system for a particular mission is outlined. An example is given where propane would be a suitable choice and reasons for its selection are outlined. The design of a low-thrust cold-gas system is considered and rather more detailed attention is paid to nozzle design and manufacture. Author (ESRO)

N67-23806# Royal Aircraft Establishment, Farnborough (England).
ATTITUDE CONTROL: MAGNETIC CONTROL ACTUATORS
W. G. Hughes *In* ESRO Spacecraft Technol. Vol. II Jul. 1966 6 p refs (See N67-23801 12-21)

Magnetic torque-producing devices are considered, covering coils for active magnetic control, and the production of de-spin torques via hysteresis in ferromagnetic rods. Author (ESRO)

N67-23807# Royal Aircraft Establishment, Farnborough (England).
ATTITUDE CONTROL: MOMENTUM EXCHANGE CONTROL ACTUATORS
W. G. Hughes *In* ESRO Spacecraft Technol. Vol. II Jul. 1966 14 p refs (See N67-23801 12-21)

The use and advantages of momentum exchange control actuators are first discussed. Equations of motion for wheel and gyro actuators are then derived. Some discussion is given on the main features of reaction wheel characteristics and construction. Author (ESRO)

N67-23808# Royal Aircraft Establishment, Farnborough (England).
ATTITUDE CONTROL: GYROS AS SENSORS
W. G. Hughes *In* ESRO Spacecraft Technol. Vol. II Jul. 1966 8 p ref (See N67-23801 12-21)

Rate gyros and integrating rate gyros are distinguished; the equation for the gimbal motion in each case is derived and the influence of the parameters discussed. The use of gyros in earth-pointing satellites to provide a yaw reference is described. Finally, the main features of gyro construction are reviewed. Author (ESRO)

N67-23809# Royal Aircraft Establishment, Farnborough (England).
ATTITUDE CONTROL: ATTITUDE SENSORS
M. B. Barnes and G. W. Brown *In* ESRO Spacecraft Technol. Vol. II Jul. 1966 34 p refs (See N67-23801 12-21)

Discussed are the basic principles governing the design of sun, earth, and star sensors which may be used in a closed-loop feedback system to stabilize the attitude of a satellite or rocket. Radio and gravity sensors are not included as these are discussed elsewhere. Lack of time prevents the detailed description and comparison of all the many devices which are, or soon will be, available and only a brief outline of these is given here. Author (ESRO)

N67-23810# Royal Aircraft Establishment, Farnborough (England).
ATTITUDE CONTROL: SPIN STABILISATION
W. G. Hughes *In* ESRO Spacecraft Technol. Vol. II Jul. 1966 15 p refs (See N67-23801 12-21)

The stability of a spinning body, with the question of nutation damping is investigated. A brief discussion is given of the effects of environmental torques in causing spin-rate reduction and spin-axis precession, and of the possibilities of active control of spin-axis attitude. Author (ESRO)

N67-23811# Royal Aircraft Establishment, Farnborough (England).
PASSIVE AND SEMI-PASSIVE ATTITUDE CONTROL OF AN EARTH-POINTING SATELLITE
N. E. Ives *In* ESRO Spacecraft Technol. Vol. II Jul. 1966 17 p refs (See N67-23801 12-21)

The basis and the tasks of the passive methods for damping attitude motion of a gravity gradient stabilized earth-pointing satellite and the semi-passive gyro systems are reviewed. Examples of both passive and semi-passive systems are given. ESRO

N67-23812# Royal Aircraft Establishment, Farnborough (England).
ATTITUDE CONTROL BY PURE JET SYSTEMS
K. J. O'Mahony *In* ESRO Spacecraft Technol. Vol. II Jul. 1966 27 p refs (See N67-23801 12-21)

The design is considered from the single-axis point of view, ignoring the effects of coupling into other axes, since the endeavor with all but earth-stabilized satellites is to equalize the moment of inertia about each axis as far as possible, in order to minimize gravity gradient torques. ESRO

N67-23813# Royal Aircraft Establishment, Farnborough (England).
ATTITUDE CONTROL: REACTION WHEEL CONTROL SYSTEMS
W. G. Hughes *In* ESRO Spacecraft Technol. Vol. II Jul. 1966 19 p refs (See N67-23801 12-21)

The linear single-axis analysis of an inertially stabilized reaction wheel control system is emphasized with brief discussion of non-linearities and gyroscopic inter-axis coupling. The considerations presented form only the preliminary stage of system study. They need to be followed by digital and analog simulations which must take full account of the various inter-axis coupling and non-linearities. ESRO

N67-23814# Royal Aircraft Establishment, Farnborough (England).
ATTITUDE CONTROL: JET AND MAGNETIC UNLOADING SYSTEMS
W. G. Hughes *In* ESRO Spacecraft Technol. Vol. II Jul. 1966 8 p refs (See N67-23801 12-21)

Before describing the jet and magnetic unloading systems, an idealized linear analysis of the unloading loop is presented. Since a jet unloading system is likely to be energized only for a few minutes per orbital period, this analysis is representative only in a very broad principle. However, a magnetic system may be operated in a relatively continuous manner, in which case the linear analysis is less than an idealization. ESRO

N67-23815 Royal Aircraft Establishment, Farnborough (England).
ATTITUDE CONTROL OF STELLAR OBSERVATORY SATELLITES
W. G. Hughes *In* ESRO Spacecraft Technol. Vol. II Jul. 1966 17 p refs (See N67-23801 12-21)

Consideration is given to the attitude control of stellar observatory satellites for the purpose of observing radiation in the ultraviolet and shorter wavelengths. The basic operational requirements of such a satellite are reviewed. Summary details are then given on the attitude control of a United Kingdom astronomical satellite, including general description, external disturbing torques, control actuators, control during coarse and fine star stabilization, control during slewing, attitude acquisition, and mass and power requirements. The general configuration and attitude control of the OAO are also discussed, and briefly compared with the U.K. satellite. L.E.W.

N67-23816# Royal Aircraft Establishment, Farnborough (England).
ATTITUDE CONTROL OF COMMUNICATION SATELLITES
J. K. Abbott *In* ESRO Spacecraft Technol. Vol. II Jul. 1966 12 p refs (See N67-23801 12-21)

It is proposed to discuss first attitude control of communication satellites in general terms and then to refer in more detail to particular systems either of existing satellites or of the proposed satellites. Two basic schemes of control feasible for communication satellites; the maintenance of full earth-pointing and the spin stabilization are considered. ESRO

N67-23817# Royal Aircraft Establishment, Farnborough (England).
ATTITUDE CONTROL SYSTEMS FOR THE MARINER, OSO AND OGO SATELLITES
W. G. Hughes *In* ESRO Spacecraft Technol. Vol. II Jul. 1966 8 p (See N67-23801 12-21)

Lecture notes are outlined for the following topics: the Mariner II attitude control system, the Orbiting Solar Observatory spacecraft, and the design of the attitude control system for the Orbiting Geophysical Observatory. Brief consideration is given to mission, configuration, control system, and operation. L.E.W.

N67-24010# Federal Aviation Agency, Atlantic City, N. J. Test and Evaluation Div.
TEST APPROACH LIGHTING FOR DISPLACED THRESHOLDS Interim Report
E. L. Reamer Sep. 1966 29 p
(RD-66-66; AD-646144) CFSTI: HC$3.00/MF$0.65

The purpose of the project was to determine the extent to which multiple semiflush-mounted in-runway lighting fixtures, both steady-burning and condenser-discharge types, could replace above-ground approach lighting fixtures to obtain an interim displaced threshold approach lighting system. The tests compared the characteristics of readily available touchdown zone fixtures in multiple groupings with those of single above-ground fixtures. The project involved flight tests under actual weather conditions, analysis of the physical and mechanical properties of the individual components, and photometric measurements of the lighting configurations and components. The results of the tests indicated that the steady-burning fixtures were adequate for Category I operations and marginally adequate for Category II operations. The multiple condenser-discharge fixtures were adequate for Category I operations and marginally adequate for the higher RVR limits (approximately 1,800 feet and above) of Category II operations. Author (TAB)

N67-24497# Federal Aviation Agency, Atlantic City, N. J. Test and Evaluation Div.
FIELD APPRAISAL OF THE STORED PROGRAM ALPHA NUMERIC BEACON SYSTEM (SPAN), APPENDIX Final Report
Joseph Levy Nov. 1966 122 p refs
(RD-66-53, Append.; AD-647827) CFSTI: HC $3.00/MF $0.65

The field appraisal of the Stored Program Alpha-Numeric Beacon System (SPAN) was conducted, using the high altitude airspace, at the Indianapolis ARTC Center between April 1965 and February 1966. The primary objective of the appraisal was to determine firm operational and technical requirements for a semi-automatic data processing and data display system designed to track radar beacon targets and present associated alpha-numeric flight data on enroute radar control displays. The track format handoff capability was one of the primary operational advantages of the system. Improvements to the tracking logic are necessary to minimize track coasting, especially in large turns, and to eliminate track format exchange. With minor exceptions, the displayed data and the display controls were found to be satisfactory. Problem areas included controller input workload, beacon data processing and the resulting tracking performance, and equipment reliability. During the appraisal period, maintenance procedures were altered and modifications to the computer program and alpha-numeric generator were made as necessary to improve the reliability and utility of the system. Author (TAB)

N67-24797# Ohio Univ., Athens. Avionics Research Group.
EARTH COVER AND CONTOUR EFFECTS ON IMAGE GLIDE PATHS, PHASE II Final Report
Richard H. McFarland, James T. Gorman, David A. Hill, Don L. Luttermoser, and David A. Miller 10 Jul. 1966 119 p refs
(Contract FA-64-WA-5060)
(EER-5-5; RD-66-39; AD-646561) CFSTI: HC $3.00/MF $0.65

The report presents the results of Phase II of a research and development effort to provide quantitative information on the effects of earth contours and ground plane snow covers on the Null-Reference, Sideband-Reference, and Capture-Effect Glide Path Systems. The mathematical model developed in Phase I (see AD-618 085) was used to predict the amplitude and position of glide path roughness at Pittsburgh, Pennsylvania; Charleston, West Virginia; and Ohio University Airport, Athens, Ohio, due to reflection of signals from irregular terrain in the approach region. Pittsburgh and Charleston predictions were confirmed by comparing with FAA flight inspection data. Development of a second mathematical model begun in Phase I was completed in this phase to provide a clear indication of effects on the monitor produced by snow coverings on the earth between the transmitter and the monitor. Computer calculations demonstrated that the glide path angle may be expected to increase or decrease at the monitor depending on the value of the dielectric constant of the snow. Low values of dielectric constant which are associated with light, fluffy, dry snow produce a decrease in path angle at the monitor and a wet snow with a high dielectric constant produces a raising of this path angle. Evidence from field measurements corroborates the calculated results. Author (TAB)

N67-24829# Naval Air Development Center, Johnsville, Pa.
INVESTIGATION OF INERTIAL SYSTEM ERROR ANALYSIS METHODS
Steven R. Ellms 29 Dec. 1966 53 p
(NADC-AM-6663; AD-646753) CFSTI: HC$3.00/MF$0.65

An investigation of several more common measures of inertial system performance is made (utilizing actual flight test data) and the circumstances under which they are satisfactory, as well as the most frequent misunderstandings that can result, are discussed. The statistical question of determining the ensemble parameters, from the point of view of designing a minimum cost test to give the desired system performance parameters, is also discussed. Author (TAB)

N67-24830# Federal Aviation Agency, Washington, D. C. Communications Development Div.
THE USE OF RADAR GATING DEVICES FOR REJECTION OF FALSE ATCRBS REPLIES
Joseph E. Herrmann Jan. 1967 11 p refs
(FAA-RD-67-1; AD-646874) CFSTI: HC$3.00/MF$0.65

In addition to valid targets, the Air Traffic Control Radar Beacon System is susceptible to signal reflections that produce false signals. The effect is most noticeable at terminal facilities where airport buildings and other structures are close to the beacon antenna site. Some long range sites may also experience reflections to a lesser degree. The Agency program for implementation of side lobe suppression is directed towards a solution of the reflection problem. Technical tests have confirmed that SLS is effective and most reflections will be suppressed. Civil transponders have SLS capability today, but military transponders will not be fully updated until 1972. When operational precautions are taken, the interim use of special beacon gating devices that rely on primary radar signals is justified at some sites until SLS is implemented. Author (TAB)

N67-24873# Federal Aviation Agency, Atlantic City, N. J. Test and Evaluation Div.
TECHNICAL EVALUATION OF EIDOPHOR Final Report
Floyd B. Woodson Sep. 1966 52 p
(RD-66-69; AD-646913) CFSTI: HC$3.00/MF$0.65

A technical evaluation of the Eidophor large screen TV display was performed. The purpose of the evaluation was to determine the equipment suitability for implementation into the air traffic control environment. The areas of concern included display

quality, equipment reliability and maintainability, projector layout, screen selection and size, interfaces with existing equipments, a system performance in an anticipated equipment configuration, and an ambient lighting system for viewing areas. It was concluded that the Eidophor is suitable for use in the air traffic control environment. Recommendations are made for equipment modifications to better the interface with existing equipments. Guidelines are established planning layout and maintenance. Documentation requirements are established. An ambient lighting system is recommended. References are made to the literature for application data. Author (TAB)

N67-24928# Naval Air Development Center, Johnsville, Pa.
A MOUNT FOR A PORTABLE INERTIAL NAVIGATION SYSTEM
A. H. Berman 20 Dec. 1966 20 p
(NADC-AM-6668; AD-647792) CFSTI: HC $3.00/MF $0.65

A feasibility investigation was made of Portable Inertial Navigation System (PINS) Mounting Provisions. A feasibility model of Interface hardware for use between (PINS) and the aircraft was designed, built and evaluated. The results of this investigation indicate that a mechanical linkage and suitable precision mounting surfaces can be developed for rapidly inserting and securing an operating (PINS) in the aircraft. Repeatability of the PINS mounting was evaluated about the azimuth, pitch and roll axes through the use of theodolites. Author (TAB)

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N67-23545# Los Alamos Scientific Lab., N. Mex.
ADVANCED REACTOR TECHNOLOGY (ART) Quarterly Status Report for Period Ending Oct. 31, 1966
Nov. 1966 28 p refs
(Contract W-7405-ENG-36)
(LA-3625) CFSTI: HC $3.00/MF $0.65

Installation of UHTREX plant and instrumentation systems is nearly complete. Analytical studies of the planned program of transient experiments have begun. Summaries are included concerning the development status of the reactor components. Work in the Na-cooled reactor program includes instrumentation testing and development, heat transfer investigations and formulation of computer programs for treating the dynamic response of entire reactor plants. Plasma thermocouple work was devoted to measurements of Cs vapor pressure, development of insulation for thermionic fuel rods, investigations of stability and fabrication of Tm_2O_3–Mo thermionic fuels, and calculations on performance of cylindrical diodes. Heat pipe tests were conducted using 80-cm-long pipes containing Na. A heat transfer limit of 5500 W at 850°C was determined. Fabrication methods for W heat pipes were investigated. A summary of investigations concerning thermal neutron effects on liquid Pu fuels is included. Fabrication and properties of Ta and Nb-base materials for Pu capsules were studied. NSA

N67-23549# Oak Ridge National Lab., Tenn.
BIBLIOGRAPHY, SUBJECT INDEX, AND AUTHOR INDEX OF THE LITERATURE EXAMINED BY THE RADIATION SHIELDING INFORMATION CENTER
S. K. Penny, D. K. Trubey, and J. Gurney May 1966 591 p refs Supersedes ORNL-RSIC-2; ORNL-RSIC-5; see N65-26999
(Contract W-7405-ENG-26)
(ORNL-RSIC-5, Rev. 1; ORNL-RSIC-5; ORNL-RSIC-2) CFSTI: HC $3.00/MF $0.65

This is the fourth cumulative edit of the literature concerned with nuclear reactors, nuclear weapons, and radioisotopes selected by the Radiation Shielding Information Center. NSA

N67-23556# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.
TWO MODE KINETICS EQUATIONS
R. L. Mathews Oct. 1966 18 p ref
(Contract W-31-109-ENG-52)
(KAPL-M-6576) CFSTI: HC $3.00/MF $0.65

A derivation of the two mode reactor kinetic equations is given and how the Perturbation Study Program (PSP) edits may be used to yield the required reactivity components is shown. Author (NSA)

N67-23583# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
COMPARISON BETWEEN THE ELMOE AND THE ITERATIVE METHODS TO GENERATE TRANSPORT AND ELASTIC REMOVAL CROSS SECTIONS FOR FAST REACTOR EVALUATIONS
A. Gandini and M. Salvatores 1966 12 p refs
(RT-FIMA-(66)-3) CFSTI: HC $3.00/MF $0.65

Elastic removal and transport cross sections were calculated for the case of a dilute PuO_2-fueled, Na-cooled fast reactor using the ELMOE code and an iterative method. Comparison of the results obtained by the two methods indicates that the iterative method is applicable to typical problems of interest. NSA

N67-23591# Kernforschungszentrum, Karlsruhe (West Germany).
COMPARISION OF THE COMPATIBILITY OF THE NUCLEAR FUEL MATERIALS UN, UC, AND UO_2 WITH METALS [VERGLEICH DER VERTRAEGLICHKEIT DER KERNBRENNSTOFFE UN, UC, UND UO_2 MIT METALLEN]
O. Goetzmann and F. Thuemmler Jun. 1966 16 p refs In GERMAN
(KFK-435) CFSTI: HC $3.00/MF $0.65

The compatibility of UN, UC, and UO_2 with Al, Be, Fe, stainless steel, Ni, Ni alloys, Ti, V, Cr, Zr, Mo, Nb, Ta, and W is outlined on the basis of a bibliographic study. NSA

N67-23596# Aerojet-General Nucleonics, San Ramon, Calif.
EVALUATION STUDY OF HASTELLOY X AS A NUCLEAR CLADDING Quarterly Progress Report, 5 Jul.–30 Sep. 1966
30 Sep. 1966 57 p refs
(Contract AT(04-3)-368)
(AGN-8205) CFSTI: HC $3.00/MF $0.65

Oxidation and mechanical property studies were carried out on low- and commercial-cobalt Hastelloy X heats. Metallography, X-ray analysis, and tensile testing were carried out for specimens exposed in air and inert gas at different temperatures. Specimens were tensile creep tested at 1800°F in air. The resulting data were compared with bending creep data; the systematic differences are attributed to imposed stress distribution and surface condition. NSA

N67-23693# Martin Co., Baltimore, Md.
SNAP 19 TEST REPORT: THERMAL PERFORMANCE OF MATERIALS AND MECHANICAL JOINTS
C. Shih Nov. 1966 52 p refs
(Contract AT(30-1)-3607)
(MND-3607-112) CFSTI: HC $3.00/MF $0.65

A study was made of the thermal contact conductance of mechanical joints for application to Nimbus B/SNAP 19 thermal analysis, of the proper joint thermal conductance in scaled thermal models, and of the thermal and mechanical properties of ZH62A Mg alloy at 300 to 783°K. For the joint conductance study, three specimens of ZH62A Mg alloy against 2024-T2Al alloy, the same materials as those used on Nimbus B spacecraft, were fabricated. One used a hexagonal-head bolt, one a counter sunk head bolt and one a rivet as fasteners. All three specimens were of approximately the same size as the prototype. Thermal conductances were evaluated at four different temperatures ranging from 340 to 566°K for each load and environment pressure. For thermal scaling of joint thermal conductance, two more specimens of stainless steel were fabricated, one approximately the same size as those used on the Nimbus B spacecraft and the other a half-scale model. The steel specimens were tested under environmental conditions identical to those experienced by the Mg–Al specimens. Contact thermal conductances of joints, typical of those used on the Nimbus B spacecraft, were measured at various temperatures, both with and without a special grease between the surfaces of contact. The measured thermal conductances of all joints with grease-coated surfaces are higher by almost an order of magnitude than the minimum value given by General Electric specifications. One of the specimens tested showed some characteristics not common to all the rest, possibly due to inaccuracy as a result of the small temperature drop across the joint under greased conditions. Thermal scaling of mechanical joints was proven to be quite feasible within the scope of interest to the Thermal Scale Model Program. Using thermal scaling criteria, scaling of material properties was within 11% at all temperatures tested. With respect to scaling to size, the experimental results agree with the criterion within 18%. The agreement of experimental results with criterion for scaling of a greased joint is about 23%. For thermal conductance of mechanical joints with a grease interface, a tolerance of 50% is recommended for thermal design purposes, due to uncertainties about the effects of temperature, pressure and time of exposure in vacuum on the thickness and density of the grease. During the measurement of materials properties, there was some uncertainty about the thermal conductivity and creep strength at temperatures close to the melting point. Verification tests of thermal conductivity of ZH62A were carried out. Some scattering of test results was noted around 770°K. NSA

N67-23724# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Atomnoi Energii.

TEST AND ANALYSIS OF AN EXPERIMENTAL ASSEMBLY OF NUCLEAR FUEL WITH SINTERED URANIUM DIOXIDE CORES IN ZIRCONIUM ALLOY JACKETS WITH MAXIMUM URANIUM BURN UP OF 68000 MWD/t [ISPYTANIE I ISSLEDOVANIE OPYTNOI SBORKI STERZHNEVHKH TVEL S SERDECHNIKAMI IZ CPECHENNOI DVUOKICI URANA V OBOLOCHKAKH IZ TSIRKONIEVOGO SPLAVA, DOSTIGSHEI MAKSIMALNOGO VYGORANIYA 68000 MVT.SUT/T URANA]

A. D. Amaev, R. S. Ambartsumyan, V. V. Goncharov, A. M. Glukhov, K. P. Dubrovin et al 1966 36 p refs In RUSSIAN
(IAE-1181) CFSTI: HC $3.00/MF $0.65

The results of loop tests and investigation in a hot laboratory assembly TVEL for the reactor of the ice breaker "Lenin" were reported. The reactor has very high burnup equal to 68,000 MWd/t. The test conditions in the water loop of the high-pressure reactors RFT and MP were discussed, and on the basis of the tests, conclusions were made on the behavior of the zirconium alloys and sintered uranium oxide during extended irradiation in a reactor and on the efficiency of the assembly of heat-releasing elements. Author (NSA)

N67-23735# Martin Co., Baltimore, Md.

SNAP 19 CAPSULE LOW REYNOLDS NUMBER FORCE TEST

C. G. Stauffer Oct. 1966 62 p refs
(Contract AT(30-1)-3607)
(MND-3607-89) CFSTI: HC $3.00/MF $0.65

The Reynolds number, based on the model length, was 1200 for the capsule and 1024 for the solar panel. The objectives of the test were to determine the aerodynamic viscous effects on the capsule and solar panel forces and stability. Normal force, axial force, and pitching moment were measured on each configuration for angles of attack from 0 to 90 degrees. The measured results are compared with calculated values, using both Newtonian impact and free molecule flow theories. Efforts to relate the measured force coefficients with theory through a transition equation were successful. Comparison of the calculated values of the capsule force coefficients with the measured results indicates that the equation can be used to predict the force coefficients at any altitude. Although the agreement of the calculated with the measured coefficients for the solar panel was not as good, the calculated values can still be used for preliminary analysis. The pitching moment coefficient about the center of gravity could not be related with theory. However, it is concluded that the measured pitching moment can be used for any altitude. It was also concluded that the effect of the notches on the face of the capsule was significant, and it was recommended that this effect should be investigated in future testing. The capsule has stable trim points at 0- and 90-degree angles of attack. The more stable trim point is at 90 degrees. Author (NSA)

N67-23736# Martin Co., Baltimore, Md.

SNAP 19 CAPSULE FORCE AND STABILITY TEST CONDUCTED IN THE NASA LANGLEY 31-INCH CONTINUOUS FLOW HYPERSONIC TUNNEL AT MACH 10

C. G. Stouffer Dec. 1966 51 p refs
(Contract AT(30-1)-3607)
(MND-3607-90) CFSTI: HC $3.00/MF $0.65

Data are presented for a Mach number equal to 10 and for Reynolds numbers, 0.758×10^6, 0.490×10^6, and 0.348×10^6, for model angles of attack from 0° to 90°. The objectives of the test were: (1) to obtain aerodynamic force and moment data in the continuum regime; and (2) to determine how the capsule pitching moment was affected by the notches in the face of the capsule. The effect of the notches in the face of the capsule was investigated from angles of attack from 35° to 90°. Shadowgraph pictures, taken at each angle of attack, were valuable in determining the effect of the notches. The results showed that, in the range tested, Reynolds number effect was negligible. The normal and axial force variation with angle of attack was similar to that predicted by application of the Newtonian theories. The magnitude of the axial force coefficient was nearly that predicted by the modified Newtonian theory. The normal force coefficient was nearly equivalent to the Newtonian values up to approximately 65° angle of attack. From 65° to 90° angle of attack, the normal force coefficient followed the modified Newtonian results. The largest variation between the measured results and theory occurred where the notch effect was significant. Here, the Newtonian theory differed from the measured results by a maximum of 12% for the normal force coefficient and 50% for the axial force coefficient. The pitching moment could not be predicted by theory. However, the variation of the pitching moment with angle of attack was similar to previous low Reynolds number results (MND-3607-89). Again, as in the low Reynolds number tests, the capsule had two stable trim points. In both tests, the more stable trim point was at 90°. Author (NSA)

N67-23744# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).

AN ASSESSMENT OF POSSIBLE PROTECTIVE COATINGS FOR BeO BASED REACTOR FUEL ELEMENTS

K. D. Reeve Jul. 1966 23 p refs
(AAEC-TM-334) CFSTI: HC $3.00/MF $0.65

Beryllium oxide based reactor fuel elements may be required to operate in moist air at temperatures in the range 1000 to 1200°C. In this environment, unprotected fuel elements would lose excessive amounts of BeO as $Be(OH)_2$. Methods of preventing this loss by means of non-reactive coatings are considered. By application of established coating principles and also criteria specific to this requirement, the most promising materials are found to be Al_2O_3 and $MgAl_2O_4$. $MgAl_2O_4$ would be difficult to apply to form a dense crack-free coating; Al_2O_3 could be applied by various methods, the best of which appear to be isostatic pressing, slip casting or spraying, and vapor deposition. It is recommended that a detailed thermal stress analysis be carried out on an Al_2O_3-coated fueled BeO sphere, and that experimental work should be concentrated on isostatic coating. Author (NSA)

N67-23761# Environmental Science Services Administration, Idaho Falls, Idaho. Air Resources Field Research Office.
A METEOROLOGICAL STUDY OF CONTAINMENT VESSEL TEMPERATURES ON AN OPERATING REACTOR
Alden P. Richter Sep. 1966 15 p refs
(IDO-12055) CFSTI: HC$3.00/MF$0.65

The containment vessel of an operating reactor (Experimental Breeder Reactor II) at the National Reactor Testing Station was instrumented with copper-constantan thermocouples to obtain temperature data. These data were correlated with ambient air temperatures and other meteorological variables. The mean ΔT (containment vessel skin-ambient air) curve plotted versus ambient air temperature range exhibits a slope of −0.20. Film stripping proved to be most directly related to atmospheric stability though normally of small magnitude. Temperature gradients are normally directed outward from the containment vessel. Diurnal temperature patterns reveal that the containment vessel behaves somewhat like a black body, absorbing insolation in the daytime and radiating energy to the atmosphere at night. Temperature patterns on the containment vessel are quite complex, especially during the daylight hours, being influenced by cloudiness, winds, atmospheric temperature gradients, and the sun angle. To date, during subzero temperatures, the reactor building as a heat source transfers heat to the atmosphere. This transfer rate maintains containment vessel temperatures well above those of the ambient air. These data represent transient periods of a few hours and may not be representative of lengthy subzero regimes. Author (NSA)

N67-23766# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
NEW PLOTTING CONCEPT FOR DATA FROM BUBBLE CHAMBER EXPERIMENTS
H. Butenschoen Oct. 1966 4 p ref
(DESY-66/29) CFSTI: HC$3.00/MF$0.65

A new concept was developed for plotting one- and two-dimensional distributions of kinematic quantities in bubble chamber experiments in connection with plotting programs such as ULTRAN or SUMX with a great saving of time. Applied to an experiment with large statistics, the new program (HYBRID-ULTRAN) has yielded a saving of time of more than 90% as compared to conventional methods. Author (NSA)

N67-23886# Kernforschungszentrum, Karlsruhe (West Germany).
MEASUREMENT OF THE THERMAL CONDUCTIVITY OF SOLIDS ESPECIALLY OF CERAMIC NUCLEAR FUELS AT HIGH TEMPERATURES [ZUR MESSUNG DER WAERME-LEITFAEHIGKEIT VON FESTKOERPERN INSBESONDERE VON KERAMISCHEN KERNBRENNSTOFFEN BEI HOECH-STEN TEMPERATUREN]
Johannes Spies Mar. 1966 45 p refs In GERMAN
(KFK-415) CFSTI: HC$3.00/MF$0.65

The thermal conductivity of ceramic nuclear fuel is to be measured to give data for the development of mixed fuels with improved thermal conductivity and to permit the proper core design for these fuels. A method is proposed for the measurement of thermal conductivity at the fuel temperatures of 800 to 2,000°C encountered in a high temperature reactor, which, physically, is based upon the one-dimensional heat flow method. In this process, a disk-shaped specimen is heated on both sides by electron beams in vacuum. The temperatures of the sides of the specimen can be measured very accurately by a photoelectric pyrometer. The heat flow penetrating the specimen perpendicular to the disk areas owing to thermal conduction is determined by adjustment of two stationary states through the arising difference in the powers emitted onto a preset side of the specimen and reflected by it, respectively. The attainable accuracy in measurement of thermal conductivity is estimated to be ±5 percent for the case of measurement of heat flow through the powers dissipated by the specimen area. The apparatus can also be designed so that measurements of neutron-irradiated nuclear fuel material in a "hot cell" are possible by remote control. Author (NSA)

N67-23890# Argonne National Lab., Ill.
PRELIMINARY DESIGN STUDY OF NEUTRON-SPECTRUM CONVERTER FOR USE IN THE JUGGERNAUT REACTOR'S EAST THERMAL COLUMN
Dale A. Herbst and James H. Talboy Jul. 1966 33 p refs
(Contract W-31-109-ENG-38)
(ANL-7244) CFSTI: HC$3.00/MF$0.65

A design study has been made for a neutron-spectrum converter for Juggernaut's east thermal column. Calculations were performed to determine: (1) the ^{235}U and ^{10}B burnup rates, (2) the neutron-flux distribution, and (3) the heat generation and resulting temperature profiles in the converter assembly. Results of calculations indicate that a practical design has been established. Author (NSA)

N67-23891# Argonne National Lab., Ill.
DESIGN, PERFORMANCE, AND EVALUATION OF SHIELDING WINDOW FOR FARET CONTAINMENT CELL
T. W. Eckels and A. Smaardyk Jul. 1966 38 p refs
(Contract W-31-109-ENG-38)
(ANL-7157) CFSTI: HC$3.00/MF$0.65

A shielding window design for use in a reactor containment structure is evaluated. The design is accomplished by the appropriate placement and sealing arrangement of thick glass slabs. Conservative capability to withstand, without damage, over two times the required design pressure of 30 psig has been achieved. High resistance to potential missile damage has been included, mainly by the ability of the first slab to absorb impact while protecting successive slabs. For extreme temperature conditions associated with "maximum credible accident" criteria, tests have demonstrated the window integrity in the same manner of protection. In this case the first slab, even if cracked, would serve as an insulating member protecting the next slabs. A high degree of visibility has been achieved by the selective arrangement of windows, adequate glass area, and a combination of glass slab sizes and thicknesses resulting in desirable angles of view. In addition, EBR-II design features for replacement of glass components have been incorporated in a manner such that replacement may be done while the integrity of the cell is maintained. Author (NSA)

N67-23892# Babcock and Wilcox Co., Lynchburg, Va.
PHYSICS VERIFICATION PROGRAM Quarterly Technical Report, Jul.–Sep. 1966
Nov. 1966 71 p
(Contracts AT(30-1)-3647)
(BAW-3647-2; QTR-2) CFSTI: HC$3.00/MF$0.65

The results of critical experiments on cores IV, V, and VI are reported. In all assemblies the basic lattice consisted of 0.475-inch-OD rods of 2.45%-enriched UO_2 arrayed on a square pitch of 0.644 inch and moderated by H_2O. The water was

poisoned with H_3BO_3 (about 1.5 gm B/l) to obtain critical assemblies approximately 5 feet in diameter. The reactivity worth of Ag–In–Cd control pins arranged in configurations typical of power reactors was measured in these cores. The results of measurements of ρ_{28}, the modified conversion ratio, and the epithermal neutron spectrum are also reported. Author (NSA)

N67-23893# Atomic Energy Commission, Washington, D. C.
PLAIN AND ANTIFRICTION BEARINGS FOR EXTREME REACTOR CONDITIONS, PART II
F. Helfrich [1964] 26 p refs Transl. into ENGLISH from Die Atomwirtschaft (Germany), no. 9, 1964 p 168–174
(AEC-TR-6839, Pt. 2)

To satisfy reactor operational requirements for safety and elimination of maintenance, experience is obtained with bearings under extreme reactor conditions. By experimental efforts in Jülich for the AVR high-temperature reactor and by cooperation with the Dragon project in Great Britain, BBC/Krupp was first able to work out design data for bearings in extremely dry He atmosphere. All tests showed the importance of MoS_2 lubricant in reducing friction and wear. The use of grease in ball bearings is also reported. Author (NSA)

N67-23894# Battelle Memorial Inst., Columbus, Ohio.
IRRADIATION OF HIGH-TEMPERATURE ACTUATOR ASSEMBLIES IN A VACUUM FOR THE SNAP-8 REACTOR SYSTEM
Sam J. Basham, William J. Zielenbach, H. Thomas Gruber, and Joseph P. Allgeier, Jr. 15 Jun. 1966 22 p refs
(Contract W-7405-ENG-92)
(BMI-X-10168) CFSTI: HC$3.00/MF$0.65

Two actuator and position-sensor devices were irradiated to integrated fast-neutron exposures of 4 and 7×10^{18} n/cm^2 in a high-vacuum environment (4×10^{-6} torr) at temperatures of 800 to 1000°F to obtain radiation-effects data for the Atomics International SNAP-8 program. Detailed measurements of the nuclear environment were made to aid in the study of radiation damage to the specimens. Temperatures and vacuum levels were monitored continuously. Actuator operational performance was monitored periodically, as were the characteristics of components (insulation resistance, resistance, impedance), to establish degradation rates and damage thresholds. Author (NSA)

N67-23896# AEG-Kernenergieanlagen, Frankfurt am Main (West Germany).
RESEARCH ON CYCLONES FOR STEAM SEPARATION IN BOILING WATER REACTORS Quarterly Report, 1 Apr.–30 Jun. 1966
30 Jun. 1966 46 p Transl. into ENGLISH from German
(Contract EURATOM-083-66-1-TEED)
(EURAEC-1699; QR-2) CFSTI: HC$3.00/MF$0.65

Experimental investigations were carried out on the use of drop type cyclones to keep free of bubbles the water refluxing through the dropping space of boiling water reactors. The cyclones were developed during previous experiments with air/water mixtures and tested with high-pressure steam/water mixtures under reactor conditions. In this period the results of the steam/water experiments were analyzed to determine how and to what extent the results of air/water experiments at low pressures and temperatures can be applied to high-pressure steam/water mixtures. In order to obtain the most reliable results, the air/water experiments were conducted in the test rig with the same geometry that was used in the steam experiments. NSA

N67-23897# General Dynamics Corp., San Diego, Calif. General Atomic Div.
THE NATURE OF CONDENSABLE FISSION PRODUCTS IN AN HTGR ENVIRONMENT
D. D. Busch 15 Apr. 1966 26 p refs Presented at the Intern. Symp. on the Decontamination of Nuclear Install., Harwell, England, 4–6 May 1966
(Contract AT(04-3)-167)
(GA-6957; CONF-660520-4) CFSTI: HC$3.00/MF$0.65

Studies were performed in the General Atomic in-pile Loop to provide information on the behavior of condensable fission products in a simulated high-temperature gas-cooled reactor environment. A diffusion-tube technique was used to determine the chemical form and concentration in which each fission product is available for reaction with coolant-system surfaces. Diffusion tubes were inserted monthly at three positions in the loop. Operating temperatures were approximately 510°C, 330°C, and 170°C, respectively. Diffusion coefficients were determined for a number of nuclides, including ^{131}I, ^{133}I, ^{134}Cs, and ^{137}Cs. Iodine and cesium normally had diffusion coefficients ranging from 0.03 to 0.1 cm^2 sec^{-1}, depending upon the temperature, indicating their presence in the helium coolant in monatomic form. Barium-140 was deposited uniformly throughout each diffusion tube, indicating local decay of its precursor, ^{140}Xe. Partial pressures were calculated from the total amount of each fission product deposited in the diffusion tube. They ranged from about 2×10^{-15} atm for ^{131}I to about 6×10^{-13} atm for ^{137}Cs. The partial pressure of ^{140}Xe calculated from ^{140}Ba data was approximately 2×10^{-16} atm. Author (NSA)

N67-23898# General Electric Co., San Jose, Calif.
ANALYSIS OF FAST REACTOR TRANSIENT RESPONSE AND SAFETY IN SELECTED ACCIDENTS
D. G. Sherer and W. G. Meinhardt Jun. 1966 78 p refs
(Contract AT(04-3)-189)
(GEAP-4787) CFSTI: HC$3.00/MF$0.65

In the development of large fast reactors, attainment of the optimum balance between safety and economic considerations is one of the most important problems to be resolved. Conceptual designs have been developed. The Doppler coefficient is the primary means by which the time available before core damage can be increased in a reactivity insertion accident and the capability for absorbing accidental reactivity insertions improved. It is therefore a principal factor in determining requirements for control system performance, and in determining the consequences of a control system malfunction. The negative radii core expansion coefficient is the dominant factor in mitigating a loss of flow accident. It appears to be easier to design high negative radial expansion coefficients into highly pancaked cores than into cores of the same size and power density but with higher L/D ratios. The reactivity effects of sodium thermal expansion can be made small enough to be of little importance in reactor safety. Under the assumption that a scram does not terminate a reactivity insertion accident, failures are most rapid and occur in the most undesirable pattern in the core at the highest operating temperatures. During a loss-of-flow accident without scram, it may be possible, in all the cores studied, to suppress coolant boiling and cladding burnout, but fuel failure due to weakened cladding at elevated temperatures is likely. Among the factors to be considered in establishing a desirable radial power profile in the core is the pattern of failure and sodium voiding that will result if a sufficiently severe accident is postulated. It may be desirable, from a safety standpoint, to maintain some coolant flow during refueling. Because of the large number of assumptions that must be made in making a study involving failure mechanisms, core designs, and postulated accidents, the results are preliminary, but serve to focus further development of analytical methods as well as transient and burnout tests. Author (NSA)

N67-23901# Aktiebolaget Atomenergi, Stockholm (Sweden).
PHYSICS EXPERIMENTS AT THE AGESTA POWER STATION

G. Apelqvist, P. A. Bliselius, P. E. Blomberg, E. Jonsson, and F. Akerhielm Sep. 1966 33 p refs
(AE-244) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. REACTOR DYNAMICS P. A. Bliselius and F. Akerhielm p 1–12 (See N67-23902 12-22)

2. REACTOR STATICS G. Apelquist (State Power Board), P. E. Blomberg, and E. Jonsson p 12–31 refs (See N67-23903 12-22)

N67-23902# Aktiebolaget Atomenergi, Studsvik (Sweden).
REACTOR DYNAMICS
P. A. Bliselius and F. Akerhielm *In its* Phys. Expts. at the Agesta Power Station Sep. 1966 p 1–12 (See N67-23901 12-22)

Dynamic measurements have been performed at the Agesta reactor at power levels from 0.3 to 65 MW (th). The purposes of the experiments have been both to develop experimental methods and equipment for the dynamic studies and to measure the dynamic characteristics of the reactor in order to check the dynamic model. The experiments have been performed with four different perturbation functions. Perturbations were introduced in the reactivity and in the load. The recordings were made of the responses of nuclear power, coolant inlet and outlet temperature and control rod position. The results are presented as step responses and transfer functions (Bode diagrams). The results from the experiments in general show rather good agreement with the results obtained from a dynamic model, which successively has been improved. Experience on reactor noise analysis based on measurements in the Agesta power reactor is discussed. It is shown that the noise measurements have given complementary dynamic information of the reactor. Author (ESRO)

N67-23903# Aktiebolaget Atomenergi, Stockholm (Sweden).
REACTOR STATICS
P. E. Blomberg, E. Jonsson, and G. Apelqvist (State Power Board) *In its* Phys. Expts. at the Agesta Power Station Sep. 1966 p 12–31 refs Prepared jointly with State Power Board (See N67-23901 12-22)

Static measurements of the physics parameters in the Agesta reactor are carried out to confirm theoretical methods for reactor calculations and to form a good basis for safe operation of the reactor. The reactivity worth of groups of control rods are determined with different methods and compared with calculations with the three-dimensional code HETERO. The xenon poisoning effects and the effect on the reactivity due to changes of the pD value of the moderator was measured. The radial power distribution is found both from the coolant temperature rise in the individual fuel channels and from an out-of-pile γ-scanning of representative fuel elements. The later method also gives an accurate measure of the average axial power distribution. The total production of steam is measured continuously. By applying corrections for heat losses this measurement gives an acceptable value for the average burnup. The burnup distribution is also calculated with HETERO. Flux fine-structure in burned fuel is measured once every year by irradiating spectrum-sensitive foils. Author (ESRO)

N67-23912# European Space Vehicle Launcher Development Organization, Paris (France).
SELECTION CRITERIA OF RADIO-ISOTOPES FOR USE IN SPACE [CRITERES DE SELECTION DES RADIO-ISOTOPES A USAGE SPATIAL]
J. P. Contzen *In its* ELDO Tech. Rev., Vol. I, No. 4 [1966] p 245–273 refs In FRENCH; ENGLISH summary (See N67-23911 12-30)

After a short description of the possible uses of radioisotopes in space, the discussion deals with the criteria to be used in selecting the most appropriate radioelements for these applications. On the basis of these criteria, a list is given of those isotopes which are currently the most suitable for propulsion and for auxiliary power generation. Author (ESRO)

N67-24000 United Kingdom Atomic Energy Authority, Harwell (England). Metallurgy Div.
THE MANUFACTURE OF M.T.R. THERMOCOUPLE FUEL PLATES
M. L. Noakes and H. Lloyd Oct. 1966 25 p ref
(AERE-M-1040) HMSO: 4s

A technique has been developed for the introduction of thermocouples into M.T.R. fuel plates in order to measure fuel core temperatures during operation. The standard fuel plate manufacturing procedure is employed with suitable modification to the core to allow the insertion of thermocouples at pre-determined positions. The process employs piano wire for the first two hot rolling passes to provide a passage for the insertion of thermocouples prior to the final operation during which the hot junction is embedded in the core. Mark II fuel elements each fitted with ten thermocouples strategically positioned along the fuel plates were manufactured and successfully operated in DIDO, PLUTO and the Danish M.T.R. at RISO. In addition, two Mark II elements each with fifteen thermocouples were manufactured to assess fuel core temperature during high power runs in DIDO. Author

N67-24015# Office of Naval Intelligence, Washington, D. C. Translation Section.
RESEARCH ON THE USE OF ORGANIC COOLANTS AND MODERATORS IN NUCLEAR REACTORS [ISSLEDOVANIYA PO PRIMENENIYU ORGANICHESKIKH TEPLONOSITELEY-ZAMEDLITELEY V YADERNYKH REAKTORAKH]
Yu. N. Aleksenko and A. M. Brodskiy 28 Oct. 1966 53 p refs Transl. into ENGLISH from Russian
(ONI-TRANS-2247; AD-645062) CFSTI: HC $3.00/MF $0.65

The paper is a review of the primary investigations of the use of high boiling organic fluids as coolants and moderators in nuclear reactors. Results of radio-chemical, thermo-physical, corrosive, and neutron-physical investigations are discussed. The paper furnishes data covering the use of destructive hydrogenation for the regeneration of products of radiolysis of organic coolants. Author (TAB)

N67-24247# Atomics International, Canoga Park, Calif.
THE METALLOGRAPHIC PREPARATION OF IRRADIATED ZIRCONIUM-10 w/o URANIUM HYDRIDE
W. E. Krupp and D. D. McAfee *In* Rocky Flats Div., Dow Chemical Co. Advan. in Metallog. 20 Oct. 1966 p 43–49 refs (See N67-24241 12-17)
(Contract AT(11-1)-GEN-8)

The method, whereby irradiated zirconium-10 w/o uranium hydride can be consistently prepared for examination, involves attack polishing with a mixture of nitric and hydrofluoric acids followed by electropolishing in oxalic acid. The resulting microstructures are evaluated with respect to existing phase diagrams. Author

N67-24248# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.
METALLOGRAPHY OF SCANDIUM, THULIUM, ERBIUM TARGETS BEFORE AND AFTER IRRADIATION
J. T. Livingston and C. L. Angerman *In* Rocky Flats Div., Dow Chemical Co. Advan. in Metallog. 20 Oct. 1966 p 50–59 (See N67-24241 12-17)
(Contract AT(07-2)-1)

The microstructures of metallic scandium and thulium and their oxides, and of erbium oxide were characterized before and after irradiation. Standard polishing and etching techniques were used. The examinations were made either on a shielded

metallograph, when the specific activities were about 600 curies per gram, or by replica electron microscopy, when the gamma activity was above permissible limits for the metallograph. The effects of irradiation were minor. Trace impurity phases in thulium and scandium metal disappeared. Grain growth was observed in thulium metal and erbium oxide. Porosity increased in scandium oxide, and decreased in erbium oxide. Author

N67-24249# Battelle-Northwest, Richland, Wash. Pacific Northwest Labs.

AUTORADIOGRAPHY AS A METHOD FOR DIFFERENTIATING PuO_2 FROM UO_2 IN IRRADIATED MECHANICALLY MIXED OXIDE FUELS

W. J. Gruber, J. L. Hascall, J. O. Blakely, and D. J. Des Chane *In* Rocky Flats Div., Dow Chemical Co. Advan. in Metallog. 20 Oct. 1966 p 60–64 refs (See N67-24241 12-17)
(Contract AT(45-1)-1830)

Autoradiographs made with cellulose nitrate have been used to locate particles of PuO_2 in a matrix of UO_2, and determine migration and diffusion of PuO_2 in irradiated mechanically mixed oxide fuels. Procedures for making and photographing autoradiographs are described. Author

N67-24250# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.

METALLOGRAPHY OF CURIUM-244 OXIDES

P. K. Smith and J. T. Livingston *In* Rocky Flats Div., Dow Chemical Co. Advan. in Metallog. 20 Oct. 1966 p 65–75 refs (See N67-24241 12-17)
(Contract AT(07-2)-1)

Details are given on a facility for metallographic analysis of curium 244 materials, which was installed in an actinide materials laboratory constructed to characterize and evaluate curium fuel forms. The procedures used to prepare curium oxides for microscopic examination are discussed briefly. These include cutting, mounting, grinding, polishing, and stereomicroscopic or metallographic examination. Polishing and etching steps for curium oxide and curium aluminum oxide are listed. Microstructures of sintered curium oxide pellets are graphically presented. Also described are the microstructures of spinels and perovskite-type ceramics produced by the reaction between alumina and curium oxide over 1600° C. M.G.J.

N67-24251# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.

REMOTE HANDLING TECHNIQUES USED IN THE STUDY OF FISSION PRODUCT DIFFUSION IN IRRADIATED METALS

Stuart A. Leighton and Willis J. Stapp *In* Rocky Flats Div., Dow Chemical Co. Advan. in Metallog. 20 Oct. 1966 p 76–83 ref (See N67-24241 12-17)
(Contract AT(40-1)-2847)

The procedures used to determine the fission product retention capabilities of tantalum, and tungsten–rhenium–molybdenum alloy materials are described. The techniques, as adapted to remote handling, include sectioning the end from the irradiated specimen, mounting it as a conductive metallographic specimen, controlling the amount of material removed during grinding and polishing, anodizing the polished surface, and stripping the anodized surface. Specimen preparation was performed in a post-irradiation metallographic cell. Gamma ray scintillation spectroscopy was used for the evaluations. M.G.J.

N67-24252# Battelle Memorial Inst., Columbus, Ohio.

AN ALPHA-GAMMA METALLOGRAPHIC FACILITY

F. E. McGrath *In* Rocky Flats Div., Dow Chemical Co. Advan. in Metallog. 20 Oct. 1966 p 84–91 (See N67-24241 12-17)

Design features and construction details are presented on an alpha–gamma metallographic facility which permits handling of radioisotopes as well as nuclear fuels. The radioactive materials are handled under a protective atmosphere, and complete containment of the materials is provided. Safety of operation and economics were the major considerations. Author

N67-24255# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

PREPARATION OF IRRADIATED SPECIMENS TO RETAIN EDGES FOR EXAMINATION OF THIN SURFACE COATINGS

W. J. Gruber, F. M. Smith, and E. C. Watts *In* Rocky Flats Div., Dow Chemical Co. Advan. in Metallog. 20 Oct. 1966 p 106–108 refs (See N67-24241 12-17)
(Contract AT(45-1)-1830)

A procedure, which is adaptable for remote preparation of irradiated materials, is described for mounting and preparing specimens to retain edges. Using this procedure, surface oxide layers less than 0.0001 inch thick have been resolved. Author

N67-24258# Atomics International, Canoga Park, Calif.

FAILURE ANALYSIS OF THERMIONIC EMITTERS

H. Taketani and J. L. Arnold *In* Rocky Flats Div., Dow Chemical Co. Advan. in Metallog. 20 Oct. 1966 p 124–136 refs (See N67-24241 12-17)
(Contract AF 33(657)-10876)

An emitter consisted of a hollow cylinder with an outer cladding of rhenium, which served as an electron emitting surface, and an inner cladding of tungsten. A cement fuel was contained within the cladding and consisted of a mixed uranium carbide fuel within a tungsten matrix. Failure was caused by the interaction of uranium with the emitter components. The mechanism for the formation of uranium from UC could not be determined. However, reaction of UC with oxygen impurities in the tungsten matrix is offered as a possibility. Author

N67-24259# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.

ELECTROLESS NICKEL PLATING OF GRAPHITE SPECIMENS

F. L. Cochran and W. P. Wallace *In* Rocky Flats Div., Dow Chemical Co. Advan. in Metallog. 20 Oct. 1966 p 137–145 refs (See N67-24241 12-17)

The problem of preserving the edge and surface detail is eliminated by nickel plating the specimen in an electroless solution containing (per liter) 30 g $NiCl_2$, 10 g NaH_2PO_2, 100 g $Na_3C_6H_5O_7$, 50 g NH_4Cl, and 30 cm^3 NH_4OH. The resulting nickel coating protects and preserves the surface and edge characteristics and prevents rounding of the specimen edge. The technique is applicable not only to graphitic materials, but to many metallic systems as well. Author

N67-24553# Oak Ridge National Lab., Tenn.

SWELLING OF UAl_3–Al COMPACTS

J. L. Gregg, R. S. Crouse, and W. J. Werner Jan. 1967 14 p refs
(Contract W-7405-ENG-26)
(ORNL-4056) CFSTI: HC $3.00/MF $0.65

Irradiation testing of ATR- and HFIR-type fuel elements containing dispersed UAl_3 in Al showed them less likely to swell or blister than oxide dispersions. However, swelling did occur in the fabrication of these types of fuel elements when the cold-pressed core materials, cold pressed to high density, were vacuum degassed at 590°C. Longitudinal dimensional changes to 8% were found in 1/2-in.-dia by 1/2-in.-high cylindrical pellets. Examination by low-magnification microscope, room-temperature and heating-stage metallography, and x-ray diffraction confirmed the transformation of UAl_3 to UAl_4. Very little volume change occurs when UAl_3

converts to UAl_4 in an Al matrix, so the swelling was thought to take place due to fuel particles changing shape and forcing the poorly bonded Al grains apart. This shape change and wedging process was observed in a heating-stage metallograph. Author (NSA)

N67-24555# Los Alamos Scientific Lab., N. Mex.
TEST CELL SHIELDING STUDY, KIWI B4D-202
A. John Ahlquist and Jerome E. Dummer 5 Jan. 1967 27 p refs
(Contract W-7405-ENG-36)
(LA-3622-MS) CFSTI: HC $3.00/MF $0.65

Gamma and neutron doses at 71 and 19 stations, respectively, in the Test Cell C complex at the Nuclear Rocket Development Station were measured during the full-power run of the Kiwi B4D-202 reactor to determine shielding effectiveness of the test cell structures. Author (NSA)

N67-24556# Atomics International, Canoga Park, Calif.
HIGH HEAT FLUX HEATER DEVELOPMENT PRELIMINARY PERFORMANCE TESTS
B. R. Hayward, E. L. Babbe, and D. K. Darley 31 Dec. 1966 14 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-12242) CFSTI: HC $3.00/MF $0.65

Surface heat fluxes exceeding 1.0×10^6 Btu/ft^2-hr are operational requirements for advanced nuclear reactor fuel elements. An electrically heated power source has been developed that simulates these nuclear fuel elements in both radial dimensions and power density. The heater element consists of a resistance heated graphite core, ≈1/8 in. diameter and 2 in. long, contained in a boron nitride electrical insulator and sheathed in stainless steel. Several of these heaters have operated in a dynamic sodium loop at surface heat fluxes of $>1.5 \times 10^6$ Btu/ft^2-hr for over 400 hr. The design, fabrication, and test results of these heaters are described. Future advances in these nuclear fuel element simulators are outlined. Author

N67-24557# Israel Program for Scientific Translations, Ltd., Jerusalem.
THE USES OF RADIOACTIVE ISOTOPES AND NUCLEAR RADIATION IN THE U.S.S.R. VOLUME TWO: CONSTRUCTION AND BUILDING-MATERIALS INDUSTRY, LIGHT INDUSTRY, FOOD INDUSTRY AND AGRICULTURE, MEDICINE
P. I. Antyshev, S. Ya. Vartazarov, A. I. Zaitsev, V. M. Zezyulinskii, G. A. Zedginidze, ed. et al 1966 273 p refs Transl. into ENGLISH of the book "Radioaktivnye Izotopy i Yadernye Izlucheniya v Narodnom Khozyaistve SSSR, Tom 2" Moscow, Gos. Nauchn.-Tekhn. Izd., 1961 Proc. of All-Union Conf., Riga, 12-16 Apr. 1960 Published for AEC and NSF
(AEC-TR-6466/2; IPST-CAT.-1242; CONF-600402, Vol. 2) CFSTI: HC $3.00/MF $0.65

The current status and prospects for future application of radioisotopes and nuclear radiations in the U.S.S.R. are reported. Topics discussed are the application of radioisotopes and nuclear radiations to the solution of industrial problems in the construction and building materials industry, light industry, food industry, agriculture, and medicine. NSA

N67-24558# Argonne National Lab., Ill.
STUDY OF REFLECTOR-BASED CONTROL OF FAST NUCLEAR ROCKET REACTORS
K. K. Almenas May 1966 82 p refs
(Contract W-31-109-ENG-38)
(ANL-7099) CFSTI: HC $3.00/MF $0.65

A comparative evaluation of a variety of reflector and control materials suitable for use with fast-spectrum, high-performance cores was carried out. The evaluation focused primarily on the control potential of reflector-located control mechanisms, though factors such as weight, volume, and critical mass savings were also considered. It was determined that for most fast-spectrum core-reflector combinations a well-defined optimum control-vane design exists. The dependence of this optimum control span on control-vane thickness and composition was explored in detail. Calculational methods for determining the optimum vane configuration and such ancillary but important aspects as control-vane heating are presented. Author

N67-24563# Atomics International, Canoga Park, Calif.
MERCURY RANKINE PROGRAM BOILER DEVELOPMENT SUMMARY
E. B. Baumeister 15 Jan. 1967 65 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-12233) CFSTI: HC $3.00/MF $0.65

The Mercury-Rankine Program NaK-to-mercury boiler development program history and present status are presented. Also included are the results of boiler conditioning studies, thermal-hydraulic boiler design procedures, and advanced application conceptual designs. Author (NSA)

N67-24569# Argonne National Lab., Ill.
DYNAMIC BEHAVIOR OF CIRCULAR PLATES AND BEAMS WITH INTERNAL AND EXTERNAL DAMPING
G. Cinelli Jul. 1966 30 p refs
(Contract W-31-109-ENG-38)
(AWL-7239) CFSTI: HC $3.00/MF $0.65

Nuclear reactors give rise to a myriad of problems involving the dynamic behavior of elastic systems. The purpose is twofold, namely, (1) to indicate the areas in which there is a need for making structural dynamic problems an integral part of nuclear reactor design; (2) to develop some new versions of a mathematical technique, known as finite integral transforms, used in solving dynamic problems. The theory of a single-degree-of-freedom system is reviewed. The dynamic response of a circular plate under various boundary conditions is considered and the problem of a cantilevered beam is treated. The beam and plate are then treated as a complete system. The results and conclusions are presented. NSA

N67-24590 Metallgesellschaft, A.G., Frankfurt am Main (West Germany).
FURTHER DEVELOPMENT OF THE ZIRCONIUM ALLOY ZrNb3Sn1 WITH A VIEW TO ITS USE AS CLADDING MATERIAL IN WATER-COOLED NUCLEAR REACTORS [WEITERENTWICKLUNG DER ZIRKONIUMLEGIERUNG ZrNb3Sn1 IM HINBLICK AUF IHRE VERWENDUNG ALS HULLMATERIAL IN WASSERGEKUHLTEN KERNREAKTOREN]
K. Drefahl, H. Richter, and W. Ruckdeschel Brussels, EURATOM Feb. 1967 109 p refs In GERMAN; ENGLISH summary
(Contract EURATOM-019-63-11 TEED)
(EURAEC-1725; EUR-2897.d)

The alloy ZrNb3Sn1 developed has about the same corrosion resistance as Zircaloy-2 in pressurized water and steam at 400°C, but much higher heat resistance and better creep behavior. In the present work an attempt has been made to effect a further improvement in the properties of this ZrNb alloy by altering the tin content and adding other alloy elements (Cu, Fe, Cr, Ge, V, Sb, Te) up to 0.5 wt.%. The results show that the corrosion behavior of the alloy ZrNb3Sn1 in steam at 400°C can only be slightly improved by variations in composition. In steam at 450°C, on the other hand, a reduction in the tin content leads to substantially more favorable corrosion properties. At these high corrosion

temperatures additions of copper, iron, chromium or antimony are particularly advantageous. Unfortunately a reduction in the tin content, which is desirable for corrosion reasons, leads to a drop in the strength and impairs the creep behavior. Since the alloys containing 1 wt.% Sn and iron additions, which do particularly well in creep tests, fail at higher corrosion temperatures, it seems conceivable that a reasonable compromise between corrosion behavior and strength may be found, on the one hand, with alloys with iron additions and low tin contents and, on the other hand, with tin-free alloys with antimony additions. Author

N67-24624*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

MAPPING A TUNGSTEN-REACTOR ROCKET ENGINE AS A GUIDE TO OPERATION AND CONTROL

Richard H. Cavicchi Washington, NASA, May 1967 88 p refs

(NASA-TN-D-3840) CFSTI: HC $3.00/MF $0.65 CSCL 21F

A nonlinear analog simulation of a preliminary tungsten water moderated reactor system indicated stability without external feedback controls. The simulation was used to obtain steady state operating maps over a mass-flow range from 20 to 120 percent. A feasible operating corridor, outlined by locating system constraints on the maps, is bounded by the bleed pump turbine speed limit at about 118 percent power and by bleed pump stall at 33 percent power. Within this corridor, system operation is confined to a 500°R range in chamber temperature by heat exchanger icing and the nozzle-wall temperature limit. The manner of operating the bleed system determined the locations of the constraints on the maps except for the nozzle-wall and fuel-temperature limits. Reactor power could be controlled by the topping-turbine bypass valve and poison reactivity. Also, water temperature was a suitable control parameter. Reactor power was approximately proportional to hydrogen flow rate. A 10-cent insertion of poison reactivity reduced reactor power by about 7 percent; less than a 3 percent change in power was accompanied by a 1°R change in water temperature. Author

N67-24629*# Aerojet-General Corp., Azusa, Calif. Von Karman Center.

SNAP-8 ELECTRICAL GENERATING SYSTEM DEVELOPMENT PROGRAM Quarterly Progress Report, 1 Oct.-31 Dec. 1966

Jan. 1967 167 p refs

(Contract NAS5-417)

(NASA-CR-72190; Rept.-3335) CFSTI: HC $3.00/MF $0.65 CSCL 18N

Power conversion system development is discussed, with progress reported on various aspects of the turbine alternator assembly, pump motor assemblies, boiler, condenser, and electrical controls. Equipment modifications, based on failure and design analyses, are detailed. The full scale SNAP-8 engine facility, arranged in a breadboard configuration, is described in terms of development engineering and system performance. Technical support capabilities are also discussed. Tabulated data are included on suggested operating conditions for a system with nominal 1200°F reactor outlet temperature, cumulative operating times for major PCS components, and classifications of nonconformance causes. M.G.J.

N67-24669# Massachusetts Inst. of Tech., Cambridge. Dept. of Nuclear Engineering.

EFFECT OF REACTOR IRRADIATION ON SANTOWAX WR: I. RADIOLYSIS REACTION ORDER AND FAST NEUTRON EFFECT. II. RADIOPYROLYSIS

E. A. Mason, T. H. Timmins, D. T. Morgan, and W. N. Bley Oct. 1966 322 p

(Contract AT(38-1)-334)

(MIT-334-70) CFSTI: HC $3.00/MF $0.65

Santowax WR was irradiated in the M.I.T. In-Pile Loop Facility at 300 and 427°C. The fast neutron and gamma dose rates were measured with adiabatic calorimeters and foil monitors. The average dose rate to the coolant was approximately 0.0066 W/g at 2 MW and approximately 0.016 W/g at 5 MW. The maximum dose rate to the coolant was 0.15 W/g and 0.38 W/g at 2 MW and 5 MW, respectively. Three low temperature irradiations were made at different steady-state concentration levels in order to determine the apparent reaction order for radiolysis. The results indicated an apparent reaction order of radiolysis of 1.7 with respect to total terphenyl concentration. Using this reaction order, the low temperature irradiation data of M.I.T. and other laboratories were correlated well by a fast neutron effect ratio, G_N/G_γ, of 3.9±0.4 for meta-rich terphenyl mixtures at 320°C. Ortho terphenyl was found to be less stable to gamma rays than meta terphenyl at this temperature. Above 350°C, irradiated coolant was found to have higher first-order thermal decomposition (radiopyrolysis) rate constants than unirradiated coolant. Author (NSA)

N67-24670# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).

A SURVEY OF THERMAL AND MECHANICAL ASPECTS OF SOME H.T.G.C. REACTOR CORE DESIGNS UTILISING BERYLLIUM OXIDE MODERATION

R. P. Gerrand, Z. J. Holy, I. M. Binns, and P. A. E. Hawker Jun. 1966 43 p

(AAEC-E-153) CFSTI: HC $3.00/MF $0.65

Results are presented of a study made from July 1962 to June 1963 of various reactor core configurations for a high-temperature gas-cooled reactor system, using fuels dispersed in unclad BeO with BeO moderation and CO_2 gas coolant. The configurations are naturally classified into two groups: one, Parallel-Channel Reactors (cores with fixed internal geometry and specific coolant channels), and the other, Pebble-Bed Reactors. The major advantages and design problems of each type are discussed. Methods for solution of the problems are suggested. Although the reactor types are compared, it is impossible to recommend any one type in preference to the others, owing to the lack of reliable nuclear and cost data. Author (NSA)

N67-24682# Oak Ridge National Lab., Tenn.

INDEX TO NUCLEAR SAFETY. A TECHNICAL PROGRESS REVIEW BY CHRONOLOGY, PERMUTED TITLE, AND AUTHOR, VOLUME 1, NO. 1 THROUGH VOLUME 7, NO. 4

Jan. 1967 65 p refs

(Contract W-7405-ENG-26)

(ORNL-NSIC-31) CFSTI: HC $3.00/MF $0.65

The KWIC (Keywork In Context) nuclear safety index is one in which article titles are permuted around the various significant words contained therein. The index is presented in three sections consisting of a chronological list of articles, a permuted title index, and an author index. Emphasized are all phases of reactor development and operation, and the various associated radiation effects. C.T.C.

N67-24894# Naval Research Lab., Washington, D. C.

IRRADIATION EFFECTS ON REACTOR STRUCTURAL MATERIALS Quarterly Progress Report, 1 Aug.-31 Oct. 1966

L. E. Steele, J. R. Hawthorne, C. Z. Serpan, Jr., and R. A. Gray, Jr. 15 Nov. 1966 30 p refs

(NRL-MR-1731; AD-646662) CFSTI: HC $3.00/MF $0.65

The research program of the NRL Metallurgy Division, Reactor Materials Branch, is devoted to the determination of the effects of nuclear radiation upon the properties of structural materials. The overall program is sponsored by the Office of Naval Research, the Naval Ship Systems Command, the U. S. Atomic Energy Commission, and the Army Nuclear Power Program. Since research

findings which apply to the objectives of one sponsoring agency are also of interest to the others, the overall program progress is reported herein. This report, covering research for the period 1 August - 31 October 1966, includes the following: (1) a comparative response of A302-B and several higher strength steels after irradiation at 200F and at 550F, (2) a comparative evaluation of the notch ductility of 3-1/2%Ni-Cr-Mo weld and base plate after irradiation at 200F and at 550F, (3) the notch ductility characteristics of irradiated AISI 304L and 347 stainless steels after exposure to 1 and 10 x 10 to the 19th power, (4) the response of A350-LF1 (Modified) steel to cyclic irradiation and annealing treatment, and (5) the through-thickness embrittlement and neutron flux variations in a simulated wall of a reactor pressure vessel. Author (TAB)

N67-24911# Atomics International, Canoga Park, Calif.
SNAP SYSTEMS IMPROVEMENT PROGRAM, MERCURY-RANKINE PROGRAM, VOLUME I Progress Report, Jul.-Sep. 1966
15 Jan. 1967 21 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-12256, Vol. I) CFSTI: HC $3.00/MF $0.65

Progress is reported in the development of a broadly based component and system test technology that may be utilized in a space flight application for reliable electric power generation of long duration. Accomplishments are presented in system engineering, component feasibility, endurance and reliability improvements, and system test evaluations. Included in these studies are shaft bearing dynamics, a rotor digital dynamic study, an instrumented boiler test, and development of a pressure regulator and injection tank. C.T.C.

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N67-23501 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CERTAIN QUESTIONS IN EXPERIMENTAL PHYSICS
26 Jul. 1966 166 p refs Transl. into ENGLISH of the book "Nekotoryye Voprosy Eksperimental'noy Fiziki, Vypusk 2" Moscow, Izd. G1. Upr. po Ispol'z At. Energ. pri Sov. Min. SSSR, 1959 p 1-124
(FTD-MT-64-178; TT-67-60491; AD-645794) CFSTI: $3.00

CONTENTS:

1. MULTICHANNEL PHOTOMULTIPLIERS FOR THE REGISTRATION OF X-RAY RADIATION L. I. Andreyeva and B. M. Stepanov p 5-17 refs (See N67-23502 12-09)

2. LINEAR GATING CIRCUIT FOR PULSES OF ANY SIGN M. N. Tsaregorodtsev p 19-23 ref (See N67-23503 12-09)

3. CALCULATION AND EXPERIMENTAL CHARACTERISTICS OF AN INSTRUMENT FOR THE MEASUREMENT OF A STABLE NUCLEAR REACTOR PERIOD P. I. Popov p 25-36 refs (See N67-23504 12-14)

4. OPERATION OF GAS-DISCHARGE COUNTERS WITH LARGE OVERVOLTAGE PULSES B. A. Dolgoshein, B. I. Luchkov, and V. I. Ushakov p 37-45 refs (See N67-23505 12-14)

5. LENSES FOR THE COMPENSATION OF THE EFFECT OF INTERSECTIONAL GAPS IN LINEAR PROTON ACCELERATORS A. D. Vlasov p 47-57 (See N67-23506 12-23)

6. CALCULATIONS OF MAGNETIC POLE PROFILES I. Ye. Irodov p 59-63 ref (See N67-23507 12-23)

7. CERTAIN IONIC-OPTICAL PROPERTIES OF STATIC AXIAL-SYMMETRIC MAGNETIC AND ELECTRICAL FIELDS A. F. Malov p 65-83 refs (See N67-23508 12-23)

8. CONCERNING THE SENSITIVITY OF THE LUMINESCENT POINT METHOD M. A. Vorob'yeva p 85-97 refs (See N67-23509 12-23)

9. SCATTERING OF μ-MESONS WITH IMPULSES NEAR 100 MEV.SEC^{-1} IN COPPER AND IRON V. G. Kirillov-Ugryumov, B. A. Dolgoshein, A. M. Moskvichev, and L. P. Morozov p 99-113 refs (See N67-23510 12-24)

10. POLARIZATION OF THE μ^+-MESON FLUX AT SEA LEVEL B. A. Dolgoshein and B. I. Luchkov p 115-120 refs (See N67-23511 12-24)

11. HEAT TRANSFER WITH TURBULENT FLOW OF MERCURY IN NARROW ANNULAR CHANNELS V. I. Petrovichev p 121-130 refs (See N67-23512 12-33)

12. DETERMINATION OF THE SPECIFIC SURFACE OF POWDERS BY ELECTRON MICROSCOPY METHODS O. N. Repkova, Da. A. Vasil'kov, and R. L. Grechnyuk p 131-144 refs (See N67-23513 12-15)

13. BALANCING DEVICE OF AN ELECTRONIC PARAMAGNETIC RESONANCE RADIOSPECTROSCOPE V. V. Vakhnina and V. F. Semenov p 145-154 refs (See N67-23514 12-14)

N67-23506 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LENSES FOR THE COMPENSATION OF THE EFFECT OF INTERSECTIONAL GAPS IN LINEAR PROTON ACCELERATORS
A. D. Vlasov *In its* Certain Questions in Exptl. Phys. 26 Jul. 1966 p 47-57 (See N67-23501 12-23)

The problem of the compensation of the unfavorable effect of intersectional gaps in linear proton accelerators with sign-alternating focusing on the radial oscillations of particles is considered. This compensating effect is proposed to be achieved with special quadrupole magnetic lenses of two types: the so-called unit, and elongated lenses. Author

N67-23507 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CALCULATIONS OF MAGNETIC POLE PROFILES
I. Ye Irodov *In its* Certain Questions in Exptl. Phys. 26 Jul 1966 p 59-63 *ref* (See N67-23501 12-23)

A method is described to calculate the pole profiles of charged particle magnetic analyzers from given field distributions in the plane of symmetry (without consideration of the edge effect). This method is applied to radial-symmetric and plane-parallel fields and is based on the solution of potential problems with the use of cubic equation tables. Author

N67-23508 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CERTAIN IONIC-OPTICAL PROPERTIES OF STATIC AXIAL-SYMMETRIC MAGNETIC AND ELECTRICAL FIELDS
A. F. Malov *In its* Certain Questions in Exptl. Phys. 26 Jul. 1966 p 65-83 refs (See N67-23501 12-23)

Research has been conducted on the nonlinear properties of crossed electrical and magnetic fields of sectional axisymmetric type with asymmetric focusing and having edges of arbitrary form are reported. The derivation of fundamental equations of beam motion in the central plane is presented. These equations are then used in the calculations of trajectories and classes of focusing fields omitting the influence of edge effects. Author

N67-23509 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CONCERNING THE SENSITIVITY OF THE LUMINESCENT POINT METHOD

M. A. Vorob'yeva *In its* Certain Questions in Exptl. Phys. 26 Jul. 1966 p 85–97 refs (See N67-23501 12-23)

The distribution of the shadow intensity produced by a thin wire is investigated. The thickness of the wire which can give a noticeable shadow is calculated. The construction of a visibility region is performed. Author

N67-23604# Institute of Modern Languages, Inc., Washington, D. C.

SPATIAL FILTRATION OF ELECTRON IMAGES AT ACCUMULATION ON TARGET [PROSTRANSTVENAYA FILTRACIA ELECTRONYKH ISOBRAJENYI PRI NAKOPLENYI NA MISHENI]

V. L. Bentsmann and A. G. Matveyeva Jan. 1967 5 p
(Contract DA-44-009-AMC-1563(T))
(ERDL-T-1884-66; TT-67-60519; AD-645946) CFSTI: HC $3.00/MF $0.65

An experiment was made to confirm that spatial filtration of electron images at accumulation on target is feasible. TAB

N67-23627# Army Electronics Labs., Fort Monmouth, N. J.

LIGHT MEASUREMENTS IN VACUUM GAPS

M. M. Chrepta and G. W. Taylor Dec. 1966 13 p refs
(ARPA Order 517)
(ECOM-2781; AD-645361) CFSTI: HC $3.00/MF $0.65

The intensity of light emitted from a gap prior to breakdown was measured as a function of voltage for gap spacings of 0.5 to 3.0 mm at 0.5 mm settings. The onset of visible light was found to occur at the same current level for any gap spacing. Four levels of infrared output were measured for the various gap spacings. A constant detector output was used as a criterion of electrode surface disruption. These measurements show that the slopes of the curves of units of infrared versus gap spacing vary from about 0.8 at the lowest level to 0.6 at the highest light intensity output level, which is just below a breakdown level. These measurements verify Cranberg's half-power law, and also might explain why other experimenters using various criteria for breakdown obtained various values of alpha. Author (TAB)

N67-23640# Brown Univ., Providence, R. I. Div. of Applied Mathematics.

SHOCK WAVES IN SOLIDS Final Report

Harry H. Calvit Oct. 1966 22 p refs
(Contract DA-18-001-AMC-866(X))
(AD-645707) CFSTI: HC $3.00/MF $0.65

A study of the literature was made concerning the propagation of finite waves in nonlinear materials. This report includes a brief review of some of the significant contributions that resulted from this study. Results of both experiment and analysis were reviewed and the general state-of-the-art was determined. The majority of the effort was found to be centered on (1) general theories of nonlinear wave propagation, (2) experiments on finite amplitude waves, (3) determination of constitutive equations to describe nonlinear behavior, and (4) development of numerical methods of solution to describe wave propagation in nonlinear materials. Simultaneously, a computer program was developed using the method of finite differences for the solution of an initial boundary value problem. Some calculations were made for the propagation of waves in a nonlinear elastic material. This was intended to be compared with experimental results obtained at the Ballistic Research Laboratories. Author (TAB)

N67-23687# General Dynamics, San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Physics.

CESIUM DEPOSITION ON STAINLESS STEEL

C. E. Milstead and L. R. Zumwalt 1 Sep. 1966 15 p refs Presented at the 1966 Winter Meeting of the Am. Nucl. Soc., Pittsburgh, 31 Oct.–3 Nov. 1966
(Contract AT(04-3)-167)
(GA-7433; CONF-661001-42) CFSTI: HC $3.00/MF $0.65

The deposition of Cs on type-304 stainless steel was measured in vacuo using ^{137}Cs-tagged cesium. Measurements were made at 660 to 1350°F over a Cs pressure range of 2×10^{-9} to 1×10^{-6} atm using specimens that were vacuum baked at temperatures ranging from 650 to 1870°F for 18 to 90 hours. Sorption isotherms were characterized by an empirical isotherm that showed a linear variation of log P_{Cs} with surface coverage and the heat of sorption decreased linearly with coverage. Cs plateout levels range from 0.5 monolayers (based on the geometric surface of the specimen) on very clean surfaces to 90 monolayers on surfaces that were slightly oxidized. The amount of Cs deposited is shown to be directly related to the temperature and duration of the bakeout period. Isosteric heats of sorption vary from about 4 to 80 kcal/mole over the range of coverage. Author (NSA)

N67-23708 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PARAMETRIC EXCITATION OF WAVES ON THE SURFACE OF A LIQUID BY AN ALTERNATING ELECTRIC FIELD

S. V. Nesterov *In its* Herald of Moscow Univ. Ser. I: Math. and Mech. 18 Aug. 1966 p 75–79 refs (See N67-23701 12-19)
CFSTI: $3.00

Presented is an analysis of nonlinear oscillations on the surface of a dielectric fluid using Bogoljubov's asymptotic method. The fluid is placed in the electric field, periodic in time, and oscillates with small but finite amplitude. The condition of parametric resonance is computed. Author

N67-23712 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE MOTION OF A GYROSTAT FIXED AT A SINGLE MOTIONLESS POINT

I. A. Keys *In its* Herald of Moscow Univ. Ser. I: Math. and Mech. 18 Aug. 1966 p 105–109 refs (See N67-23701 12-19)
CFSTI: HC $3.00/MF $0.65

Established are conditions for the existence of regular precession in the motion of a gyrostat fixed at a single point under the action of gravity forces. An analogue of Grioli's case is obtained and it is pointed out that with a proper choice of $\overline{m}(t)$ the gyrostat will perform a prescribed motion $\psi = \psi(t)$, $\phi = \phi(t)$, $\theta = \theta(t)$. Author

N67-23776# Commissariat a l'Energie Atomique, Saclay (France).

COMPRESSION OF MAGNETIC FIELDS USING EXPLOSIVES [COMPRESSION DE CHAMPS MAGNETIQUES A L'AIDE D'EXPLOSIFS]

C. Aycoberry, Y. Papillon, and J. P. Plantevin [1966] 45 p ref In FRENCH
(NP-16441) CFSTI: HC $3.00/MF $0.65

Two theoretical approaches used for the calculation of the compression of magnetic fields with explosives are outlined. Experimental apparatus for the measurement of compression is described, and measurements are reported. The theoretical results are comparable to those reported previously by Fowler. The experimental results show that the compression is almost independent of the initial field, in opposition to theory. The agreement between theory and experiment is, however, satisfactory up to compression ratios of the order of 4. The value of the field has no effect on the movement of the tamper for the first 5 μ sec. NSA

N67-23781# Naval Ordnance Lab., Corona, Calif.
FOUNDATIONAL RESEARCH PROJECTS Quarterly Report, Jul.–Sep. 1966
1 Dec. 1966 104 p refs
(NO/LC-688; AD-645930) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. CODER COMPONENTS PROGRAM. HIGH-SPEED ANALOG MULTIPLIER R. L. King and R. L. Conger p 1–5 ref (See N67-23782 12-08)

2. INFRARED ATOMIC SPECTRA. PHOTOGRAPHIC VACUUM INTERFEROMETRIC OBSERVATIONS ON THE SPECTRA OF ^{86}Kr AND ^{136}Xe C. J. Humphreys and E. Paul, Jr. p 7–24 refs (See N67-23783 12-23)

3. PLASMA PHYSICS. COHERENT EXCITATION OF ATOMS T. Hadeishi p 25–33 refs (See N67-23784 12-25)

4. SEMICONDUCTOR PHYSICS. TWO-PHONON MATRIX ELEMENTS AND ABSORPTION FOR CRYSTAL MODELS WITH ZINC BLENDE STRUCTURE A. Nedoluha p 35–54 refs (See N67-23785 12-26)

5. SOLID STATE SPECTROSCOPY INTERMEDIATE-COUPLING ENERGY LEVELS OF Sm^{3+} IN LaF_3 H. E. Rast, J. L. Fry, and H. H. Caspers p 55–86 refs (See N67-23786 12-24)

6. A NEW DEVELOPMENT IN IONIC CRYSTAL THEORY E. H. Hygh and J. D. Merriam p 87–97 refs (See N67-23787 12-26)

N67-23783# Naval Ordnance Lab., Corona, Calif.
INFRARED ATOMIC SPECTRA. PHOTOGRAPHIC VACUUM INTERFEROMETRIC OBSERVATIONS ON THE SPECTRA OF ^{86}Kr AND ^{136}Xe
C. J. Humphreys and E. Paul, Jr. *In its* Foundational Res. Proj. 1 Dec. 1966 p 7–24 refs (See N67-23781 12-23)

Observations made with Fabry–Perot interferometers on the first spectra of ^{86}Kr and ^{136}Xe, in the wavelength intervals 4275–4808 Å and 7589–9165 Å, are reported. Intercomparisons are made with I.A.U.-recommended visible standards of ^{198}Hg I. Most of the photographically accessible transitions in the category 1s–2p occur within the noted infrared interval for ^{86}Kr I and within both intervals for ^{136}Xe I. Author

N67-23832# Parke Mathematical Labs., Inc., Carlisle, Mass.
TRANSIENT SOUND FIELD OF SIMPLE ARRAYS OF CIRCULAR PISTONS
C. H. Sherman and D. A. Moran Nov. 1966 39 p refs
(Contract N00140-66-C-0172)
(SR-1; AD-644539) CFSTI: HC $3.00/MF $0.65

The problem of acoustic radiation from a circular piston with arbitrary velocity in a plane, rigid baffle is used as the basis for a study of transient effects in the near field of simple, steered arrays. Several specific examples are considered, and the total sound pressure is calculated as a function of time in an attempt to answer certain questions about possible undesirable effects of transients in Sonar arrays. Although the examples are quite limited, it can be tentatively concluded that transients in the piston velocities, rather than propagation effects, tend to control the development of the sound field, and that cavitation is not likely to be initiated by transient effects. Author (TAB)

N67-23961# Library of Congress, Washington, D. C. Aerospace Technology Div.
FOREIGN SCIENCE BULLETIN, VOLUME 3, NO. 1
Jan. 1967 66 p refs

CONTENTS:

1. MICROWAVE ELEMENTS BASED ON AVALANCHE-TRANSIT DIODES S. Hibben p 1–9 refs (See N67-23962 12-09)

2. RARE-EARTH ELEMENT CHELATES AS ACTIVE LASER MATERIALS J. Kourilo p 10–20 refs (See N67-23963 12-26)

3. SCIENCE & TECHNOLOGY NOTES p 21–38 refs

4. CONFERENCES p 39–43 refs

5. SCIENCE PERSONALITIES p 44–45 ref

6. BOOK REVIEWS p 46–60

N67-24141 Polish Academy of Sciences, Warsaw. Institute of Basic Technical Problems.
PROCEEDINGS OF VIBRATION PROBLEMS, VOLUME 7, NO. 4
1966 153 p refs

CONTENTS:

1. AMPLIFICATION OF ULTRA AND HYPERSONIC SURFACE WAVES IN DIELECTRICS BY MEANS OF CURRENT FLOWING IN A THIN PIEZO-SEMICONDUCTOR BOUNDARY LAYER S. Kaliski p 277–285 refs (See N67-24142 12-26)

2. PARAMETRIC SELF-EXCITED VIBRATION OF A PLATE OF FINITE LENGTH IN PLANE SUPERSONIC FLOW Z. Dzygadlo p 287–309 refs (See N67-24143 12-32)

3. ON A CERTAIN CLASS OF CLOSED-FORM SOLUTIONS OF THE PROPAGATION PROBLEM OF ELASTIC–VISCO–PLASTIC WAVES IN NONHOMOGENEOUS BARS E. Wlodarczyk p 311–327 refs (See N67-24144 12-32)

4. PROPAGATION OF AN ACOUSTIC WAVE IN A NON-NEWTONIAN VISCOUS LIQUID A. Opilski p 329–335 refs (See N67-24145 12-12)

5. NOETHER'S THEOREM FOR A CONTINUOUS MEDIUM INTERACTING WITH EXTERNAL FIELDS D. Rogula p 337–346 refs (See N67-24146 12-23)

6. AERO-MAGNETO-FLUTTER OF A PLANE DUCT OF FINITE LENGTH L. Solarz p 347–362 refs (See N67-24147 12-32)

7. SCATTERING OF RAYLEIGH WAVES AT A RANDOM BOUNDARY OF AN ELASTIC BODY K. Sobczyk p 363–386 refs (See N67-24148 12-32)

8. TRAVELLING SURFACE WAVES IN FINITE SYSTEMS S. Kaliski p 387–402 refs (See N67-24149 12-26)

9. SURFACE WAVES IN PIEZOQUARTZ S. Kaliski, J. Kapelewski, and Z. Makowski p 403–419 refs (See N67-24150 12-26)

N67-24146 Polish Academy of Sciences, Warsaw. Institute of Basic Technical Problems.
NOETHER'S THEOREM FOR A CONTINUOUS MEDIUM INTERACTING WITH EXTERNAL FIELDS
D. Rogula *In its* Proc. of Vibration Probl., Vol. 7, No. 4 1966 p 337–346 refs (See N67-24141 12-23)

The principle of stationary action is formulated for a system composed of a continuous body and certain external fields, and the form of the conservation laws resulting, by virtue of Noether's theorem, from the symmetry of the system is studied. Introducing a material medium as a subsystem gives the problem a special character because the body should be studied as a continuum of material particles rather than as a field. To determine the body state, certain additional quantities are introduced, in addition to the displacement field, which characterize the internal state of the material points of the body. The fields of these quantities have a physical character different from those in vacuum, and are attached to the body, not to the space. As a result, the form of the conservation laws is modified so that the general expressions valid for fields in vacuum are no longer applicable. In describing the body-field system, geometrical Cartesian coordinates and a system of material coordinates which is Cartesian in the reference configuration are used. Author

N67-24237# Brown Univ., Providence, R. I. Div. of Applied Mathematics.
SOUND PROPAGATION
Lawrence Sirovich *In* Brookhaven Natl. Lab. Summer Inst., on Spectral Theory and Statist. Mech., 1965 Nov. 1966 p 191–221 refs (See N67-24231 12-19)

The governing equations of sound (assuming that sound propagation is justified as a linear theory) from the continuum equation and Boltzmann equation (kinetic theory) approaches are given. Various one-dimensional sound problems are classified. The discussion of propagation theory presented for sound in a rarefied gas utilizes molecular diameters, number densities of particles involved, mean free paths, and collision frequency. The non-convergency of certain formal power series expansions relating to sound propagation in a gas is demonstrated. L.S.

N67-24239# National Bureau of Standards, Washington, D. C.
BROWNIAN MOTION MODELS
Robert J. Rubin *In* Brookhaven Natl. Lab. Summer Inst. on Spectral Theory and Statist. Mech., 1965 Nov. 1966 p 284–297 refs (See N67-24231 12-19)

The Brownian motion behavior of a particle is described by the Langevin equation in terms of two phenomenological constants β and D. The formal solution of the equation is outlined. A classical system of coupled oscillators for which it is possible to determine formally exact expressions for joint probability distribution functions is considered to obtain the velocity and position of the particle. Three theorems concerning the above distribution, and a cononical distribution function which characterizes thermal equilibrium (an example of a multivariate normal probability distribution function) are summarized. Matrix algebraic techniques are used. Other specially coupled oscillator systems, in which the time-dependent behavior of the position and velocity moments can be explicitly determined are also considered. These systems are for one and two dimensional heavy crystal lattice particle systems both with and without boundary conditions. L.S.

N67-24240# State Univ. of New York, Stony Brook. Dept. of Physics.
MATHEMATICAL PROBLEMS OF STATISTICAL MECHANICS
M. Dresden *In* Brookhaven Natl. Lab. Summer Inst. on Spectral Theory and Statist. Mech., 1965 Nov. 1966 p 298–338 (See N67-24231 12-19)

The utilization of the Hamiltonian, and contraction and projection operator techniques for describing macroscopic behavior in classical and quantum mechanical systems, are examined. Matrix analysis is used to solve problems involving the distribution properties of the system particles. Perturbation theory is also discussed. L.S.

N67-24312# Library of Congress, Washington, D. C. Aerospace Technology Div.
FOREIGN SCIENCE BULLETIN, VOLUME 3, NUMBER 3 Monthly Review of Selected Foreign Scientific and Technical Literature
Mar. 1967 127 p refs Sponsored by DOD
CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. THE NATURE OF THERMIONIC EMISSION Z. Litynski p 1–14 refs (See N67-24313 12-23)

2. RECURRENCE ALGORITHMS OF PATTERN RECOGNITION L. Kacinskas p 15–19 refs (See N67-24314 12-10)

3. UNDERGROUND ELECTROMAGNETIC WAVE PROPAGATION S. G. Hibben p 20–32 refs (See N67-24315 12-07)

4. THE GAS LASER IN A MAGNETIC FIELD Y. Ksander p 33–64 refs (See N67-24316 12-16)

5. ATRANES S. Parandjuk p 65–117 refs (See N67-24317 12-06)

N67-24313# Library of Congress, Washington, D. C. Aerospace Technology Div.
THE NATURE OF THERMIONIC EMISSION
Zygmunt Litynski *In its* Foreign Sci. Bull., Vol. 3, No. 3 Mar. 1967 p 1–14 refs (See N67-24312 12-23)

Conflicting views are presented of the fundamental mechanisms of thermionic emission. One theory stresses that the factors which determine the work function for a given surface are the constitution and structure of the emitter's surface layers alone. The other theory assumes that the properties of electron emitting surfaces are determined by the electron structure in the volume of the crystal, and that the work function is a physical characteristic of the solid in its bulk as well as on its surface. It is concluded that neither theory can provide materials with work functions or current densities necessary for present day aerospace applications. C.T.C.

N67-24554# California Univ., Berkeley. Lawrence Radiation Lab.
REFLECTION OF POLARIZED LIGHT FROM ABSORBING MEDIA
J. Richard Mowat and Rolf H. Muller Aug. 1966 108 p refs
(Contract W-7405-ENG-48)
(UCRL-11813) CFSTI: HC $3.00/MF $0.65

Reflection of polarized light from absorbing media, such as a bare metal surface in contact with a dielectric, results in characteristic changes in the polarization state from which the optical constants of the reflecting interface can be determined. Starting from Maxwell's equations of electromagnetic theory, the basic relationships of metallic reflection and exact formulas for relating the optical constants with amplitude and phase changes upon reflection are derived and illustrated by extensive numerical data. Author (NSA)

N67-24565# California Univ., Livermore. Lawrence Radiation Lab.
SOME PROBLEMS IN THE COMPUTER SIMULATION OF MOBILITY MEASUREMENT EXPERIMENTS AND OTHER ION SWARM EXPERIMENTS
William S. Barnes 30 Nov. 1966 19 p refs
(Contract W-7405-ENG-48)
(UCRL-14558, Rev. I) CFSTI: HC $3.00/MF $0.65

In cases where it is not expedient to eliminate the first-order or mobility term from the mobility–diffusion equation by a transformation of coordinates, the finite difference approximation, $(N_m - N_{m-1})/\Delta x$, of the first-order derivative introduces an artificial second-order or diffusion effect in the difference equation solution of this partial differential equation. It is shown that this effect may be removed by replacing D, the coefficient of the second-order term, by $D - (V/2)(\Delta x - V\Delta t)$, where V is the coefficient of the first-order term. The solution of the modified difference equation is shown to approach the analytical solution asymptotically for an initially closely localized ion distribution, and the ion distribution is shown to have the same variance as the analytical solution throughout the calculation. The additional restrictions on zone size and time step size necessitated by this modified differencing scheme are discussed. The modified differencing scheme can be seen to be symmetric, i.e., it works equally well for positive or negative values of V. An alternative scheme, the use of a travelling Eulerian reference frame, which removes or reduces this artificial diffusion effect, is also considered. A typical problem is solved to illustrate and compare several of the computational schemes discussed. Author (NSA)

N67-24567# California Univ., Livermore. Lawrence Radiation Lab.
COMPENDIUM OF SHOCK WAVE DATA, SECTIONS A-1, A-2
M. van Thiel, ed. Jun. 1966 608 p refs
(Contract W-7405-ENG-48)
(UCRL-50108, Vol. 1) CFSTI: HC$3.00/MF$0.65

Tables and graphs are presented which give the thermodynamic data in condensed media obtained by shock wave techniques. Both dynamic variables and volumetric quantities associated with the shock wave are given. The media covered include elements and compounds. NSA

N67-24691# Hamburg Univ. (West Germany).
EQUAL TIME COMMUTATORS OF RENORMALIZED CURRENT OPERATORS IN PERTURBATION THEORY
J. Langerholc Hamburg, Deutsches Elektronen-Synchrontron, Oct. 1966 11 p refs Sponsored in part by NSF
(DESY-66/24)

The conjectures derived by applying canonical commutation relations to formally defined currents are tested by forming the actual commutators of the renormalized current operators obtained from perturbation theory (up to second order) and taking an equal time limit. It is shown that consideration of renormalization phenomena leads to conclusions differing from those obtained in previous perturbational calculations; in certain models the commutator of two zeroth components of vector or axial vector currents diverge at equal times. Author (NSA)

N67-24717# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE REALIZATION OF PARTICLE-LIKE SOLUTIONS OF THE EINSTEIN EQUATIONS FOR A SCALER COMPLEX FIELD
M. I. Stakvilevichus 5 Dec. 1966 12 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. III, Fiz.-Astron. (Moscow), no. 6, 1964 p 41-47
(FTD-HT-66-278; AD-646931) CFSTI: HC$3.00/MF$0.65

It is shown that the Einstein equation with an energy-pulse tensor of a scaler complex field in the right half allow spherically symmetrical particle-like solutions, wherein the matrix has a Schwarzschild character at great distances. In the approximation of a weak gravitational field the course of the matrix approaches that of the corresponding matrix of the Newton potential. The possibility of obtaining the spectrum of the masses of scalar particles by the solution of precise equations and the introduction of a scalar quantized quasi-charge is indicated. Author (TAB)

N67-24722# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE TRANSFORMATION OF A BEAM DURING INTERACTION OF LIGHT WITH A SUBSTANCE
F. I. Fedorov 5 Dec. 1966 13 p refs Transl. into ENGLISH from Zh. Prikl. Spektroskopii (USSR), v. 4, no. 1, 1966 p 58-63
(FTD-HT-66-651; TT-67-60771; AD-646376) CFSTI: HC $3.00/MF$0.65

The transformation of the tensor of a light beam during Rayleigh scattering and the elementary volume of a luminescent substance, a luminescent crystal and during Fresnal reflection and refraction of light is considered. It is shown that the proposed covariant method is considerably more rapid and leads to the required results more simply than when Stokes parameters are used. Author (TAB)

N67-24849# Naval Ordnance Lab., White Oak, Md.
FAR INFRARED DIODE EMISSION EXPERIMENTS Interim Progress Report
John L. Davis 2 Dec. 1966 25 p refs
(NOLTR-66-163; AD-647251) CFSTI: HC$3.00/MF$0.65

Concepts leading to the possibility of infrared emission from the depletion region of a PN junction when placed in a magnetic field are discussed. The first of these is the phenomenon of guided electromagnetic waves propagating along the depletion region of a PN junction. The second is the possibility of exciting these waves by transitions of electrons between the magnetic energy levels. A super conducting magnet and a zinc doped germanium photodetector used for experimental tests are described. Some preliminary experiments and suggestions for further work are presented. Author (TAB)

N67-24916# California Univ., Santa Barbara.
LIGHT SCATTERING BY LIQUIDS AND MOLECULAR SOLIDS
Stanley Leland Shapiro (Ph.D. Thesis) Jan. 1967 67 p refs
(Contract Nonr-4222(01); ARPA Order 125)
(TR-21; AD-646515) CFSTI: HC$3.00/MF$0.65

Measurements of the frequency broadening caused by molecular rotations were made in liquid carbon disulfide and in liquid mixtures of carbon disulfide and carbon tetrachloride by observing scattered light from an Ar(+) laser at 4880A. The spectral shape of the scattered light was found to be nearly Lorentzian. Half-widths of the scattered radiation in carbon disulfide range from about 0.1/cm near the triple-point to 6/cm near the boiling point. Addition of carbon tetrachloride to carbon disulfide at room temperature causes the half-widths to decrease. Measurements of the frequency broadening were used to calculate relaxation times for the attenuation of molecular rotations in liquids. Vibrational Raman scattering was excited in liquid and solid carbon monoxide and nitrogen, and orientation scattering was studied in liquid oxygen. Brillouin scattering measurements were made in room temperature liquids in which an Ar(+) laser has been used as a source of excitation. A He3-Ne laser was used to excite Brillouin scattering in liquid NH3 and ND3. Measurements of the Brillouin shifts were used to calculate the velocity of sound of the phonons in the gigacycle frequency range. Velocity dispersions at about 2Gc in liquid NH3 and ND3 have been postulated to be due to a structural relaxation of the liquids. TAB

N67-24950# Naval Research Lab., Washington, D. C.
SYSTEMATIC ERRORS IN ULTRASONIC PROPAGATION PARAMETERS MEASUREMENTS. PART 3: SOUND SPEED BY ITERATIVE REFLECTION-INTERFEROMETRY
V. A. Del Grosso 9 Aug. 1966 252 p refs
(NRL-6409; AD-647356) CFSTI: HC$3.00/MF$0.65

This report shows that, although the free-field diffraction and guided mode dispersion errors detailed in Parts 1 and 2 of this series do carry over to the case of iterative reflection (accomplished by adding a termination to the liquid cylinder), the errors for a given geometrical configuration are smaller for interferometry than for nonterminated or pulsing situations. Indeed, the approach with improved parameters is toward plane wave results for interferometry rather than toward free-field results as is the case for pulsing. Other advantages accruing to interferometry are (a) the use of differential instead of total, acoustic paths, (b) the simplified determination of these paths by the use of parallel source and reflector, (c) the simple measurement of frequency rather than small time intervals, and (d) the suitability of the method for determinations of chemical concentration (salinity) and pressure coefficients, as well as the temperature coefficient. This report includes many impedance circle plots as well as the more usual reaction plots for ultrasonic interferometers with walls that are either infinitely flexible, absolutely rigid, liquid, or elastic. Various parameters including tube size, source-to-reflector separation, frequency, and attenuation coefficients are included along with several imposed characteristics. The plot readings, and apparent sound speeds calculated from them, are tabulated. Errors may be as large as a few percent or as small as 6 parts per million (0.01 m/s). Author (TAB)

N67-25053*# Bolt, Beranek, and Newman, Inc., Van Nuys, Calif.
THE PROPAGATION OF SOUND FROM AIRPORT GROUND OPERATIONS
Peter A. Franken and Dwight E. Bishop Washington, NASA, May 1967 570 p refs
(Contract NAS1-5063)
(NASA-CR-767) CFSTI: HC$3.00/MF$0.65 CSCL 20A

An experimental study has been performed to investigate the sound propagation losses associated with aircraft ground operations. Downwind propagation is emphasized. The noise from the initial part of jet aircraft takeoff was found to be the most reliable high-level source for the study. Noise measurements were made at Los Angeles International and Denver Stapleton Airports. Data acquisition and reduction procedures are summarized. The data have been grouped according to various meteorological parameters, and the results are compared with previous results. These show a pronounced increase in low frequency attenuation, reaching a maximum in the frequency range of 125 to 250 Hz. All valid data and a simple engineering procedure for estimating downwind propagation losses are given. Author

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N67-23510 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SCATTERING OF μ-MESONS WITH IMPULSES NEAR 100 MeV-sec^{-1} IN COPPER AND IRON
V. G. Kirillov-Ugryumov, B. A. Dolgoshein, A. M. Moskvichev, and L. P. Morozov *In its* Certain Questions in Exptl. Phys. 26 Jul. 1966 p 99-113 refs (See N67-23501 12-23)

Scattering of μ-mesons in four-millimeter copper plates (range of impulse of μ-mesons from 85 to 144 MeV-sec^{-1}) and iron plates (range of impulses of μ-mesons from 81.2 to 135 MeV-sec^{-1}) has been studied. Angular distributions of μ-mesons, averaged over 2350 scattering events agree satisfactorily with a point nucleus distribution. Author

N67-23511# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
POLARIZATION OF THE μ PLUS-MESON FLUX AT SEA LEVEL
B. A. Dolgoshein and B. I. Luchkov *In its* Certain Questions in Exptl. Phys. 26 Jul. 1966 p 115-120 refs (See N67-23501 12-23)

The degree of polarization of cosmic μ^+ mesons with impulses of $p \geq 1.2$ BeV/sec was investigated. A value of 0.98 as the degree of polarization was obtained. Author

N67-23547# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
STUDY OF THE DOUBLE CHARGE-EXCHANGE COLLISION CROSS SECTIONS OF H^+, D^+ Li^+ IONS WITH ORGANIC MOLECULES IN THE ENERGY RANGE 10 TO 50 KeV [ETUDE DES SECTIONS EFFICACES DE DOUBLE ECHANGE DE CHARGES (σ 1-1) D'IONS H^+, D^+, TRAVERSANT DIFFERENTS GAZ ORGANIQUES DANS UNE GAMME D'ENERGIE COMPRISE ENTRE 10 ET 50 KeV]
Samad Farrokhi (Ph.D. Thesis—Paris Univ.) 1966 79 p refs In FRENCH
(CEA-R-2952)

The variation of the double charge-exchange collision cross sections of H^+, D^+, Li^+ ions with organic molecules (CH_4, C_2H_6, C_3H_3, C_4H_{10}) in the energy range 10 to 50 keV has been studied. Several maximums for $\sigma_{1-1} = f(E)$ have been shown. Their existence should be explained by the different possibilities of dissociating the target molecules. The position of the maximum for the $H^+ \rightarrow H^-$ and $D^+ \rightarrow D^-$ reactions is in good agreement with that defined by Massey's adiabatic relation. Author (NSA)

N67-23551# Minnesota Univ., Minneapolis. School of Physics.
[ON THEORETICAL PHYSICS] Progress Report, 1 Sep. 1965-31 Aug. 1966
31 Aug. 1966 43 p refs
(Contract AT(11-1)-1371)
(COO-1371-36) CFSTI: HC$3.00/MF$0.65

A progress report is presented on the experimental and theoretical research activities at the University of Minnesota in high-energy physics and nuclear physics. NSA

N67-23555# Union Carbide Nuclear Co., Oak Ridge, Tenn. Oak Ridge Gaseous Diffusion Plant.
THERMAL DIFFUSION COLUMN SHAPE FACTORS. PART II. SHAPE FACTORS BASED ON THE LENNARD-JONES (6-12) INTERMOLECULAR FORCE MODEL
E. Von Halle and R. L. Hoglund 27 Dec. 1966 285 p refs
(Contract W-7405-ENG-26)
(K-1679) CFSTI: HC$3.00/MF$0.65

The separation of a binary gaseous mixture, which can be obtained in thermal diffusion columns, can be calculated theoretically from the transport equation, $\tau = Hx(1-x) - (K_c + K_d)\, dx/dz$, where τ is the net transport of light component toward the top of the column, x is the mole fraction of the light component in the mixture, z is the axial column coordinate, and H, K_c, and K_d can be calculated for a gaseous mixture of isotopes that obeys the Lennard-Jones (6-12) intermolecular force model. The shape factors are presented in a table, from which the transport coefficients may be calculated for concentric-tube or hot-wire columns, are to be used with the radius of the cold wall, r_1, and with the physical properties of the process gas evaluated at the temperature T_1, the temperature of the cold wall. These shape factors are defined in the manner originally proposed by Jones and Furry for hot-wire thermal diffusion columns and may be compared directly with the shape factors reported in the literature by other investigators. The shape factors presented in another table, from which the transport coefficients may be calculated for flat-plate columns, are to be used with the plate width and spacing, using physical properties of the process gas evaluated at the arithmetic average of the hot and cold wall temperatures. The shape factors reported are based on an assumed Lennard-Jones (6-12) intermolecular force model and are tabulated as a function of the reduced temperature $T_1^* = T_1 k/\epsilon$, where ϵ/k is a characteristic reduced energy of interaction between the molecules of the gas, the ratio of the temperature of the hot wall to that of the cold wall, and, in the case of the first table, the ratio of the radius of the outer wall to that of the inner wall. The ranges of T_1 from 0.8 to 40.0, of the radius ratio from 1.0 to 100.0, and of the temperature ratio from 1.50 to 10.0 are included. Author (NSA)

N67-23557# Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science.
INTERMEDIATE STRUCTURE
Sep. 1966 23 p refs Presented at the Intern. Conf. on Nuclear Phys., Gatlinburg, Tenn., Sep. 1966
(Contract AT(30-1)-2098)
(MIT-2098-273; CONF-660906-37)

A summary is given of the phenomena of intermediate structure in nuclear reaction cross sections, which is analyzed in terms of an intermediate amplitude with resonances. These

resonances are associated with doorway states. When the energy of the interacting system is close to that of the doorway state and if that state has a sufficiently small down width, an associated structure in the cross section can be expected. The procedure of separating out the important configurations from the complex states induced by the interaction is familiar in bound-state calculations, except that in the case of scattering the amplitude of the doorway state in the wave-function can be quite small. NSA

N67-23558# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
DETERMINATION OF THE PROBABILITY OF THE CHANNEL REALIZATION OF NUCLEAR REACTION [OPREDELENIE VEROYATNOSTI OSUSHCHESTVLENIYA KANALA YADERNOI REAKTSII]
V. I. Moroz, A. V. Nikitin, Yu. A. Troyan, and B. A. Shakhbazyan 1966 7 p refs In RUSSIAN
(JINR-P10-2935)

The problem of separation of recorded events into nuclear reaction channels is considered. A general expression for the probability of the channel realization of nuclear reaction is derived by the maximum likelihood method. Author (NSA)

N67-23559# Oak Ridge National Lab., Tenn.
TACS: A CODE TO CALCULATE FAST REACTOR GROUP CROSS SECTIONS FROM POINT DATA FOR PRIMARY USE IN S_n TRANSPORT CODES
O. L. Smith Dec. 1966 91 p ref
(Contract W-7405-ENG-26)
(ORNL-TM-1610) CFSTI: HC $3.00/MF $0.65

A code is described which calculates the group-averaged cross sections required for fast reactor analysis. The cross section formulations are oriented toward use in the S_n transport codes of Carlson, although some of the formulations may have a more general use. The code evaluates isotropic and linear anisotropic elastic scattering, inelastic scattering according to the individual level model and the evaporation model, non-resonance absorption and fission, and (n,2n) reactions. Group-averaged cross sections are generated from point data input on cards. An arbitrary group structure of up to 500 groups is allowed. A number of flux weighting options are built into the code, or the user may read in on cards any flux he wishes. Output may be punched on cards in a format consistent with the Fortran versions of the S_n codes. Considerable mathematical development is given in the cross section formulations. The code is written in Fortran II for the IBM 7090 computer. Author (NSA)

N67-23560# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
REDUCTION SCHEME OF THE AMPLITUDE FOR THE PROCESSES $eN \rightarrow eN\pi$ AND $\pi N \rightarrow Ne^-e^+$ BY THE EXPERIMENTAL DATA [SKHEMA VOSSTANOVLENIYA AMPLITUDY PROTSESSOV $eN \rightarrow eN\pi$ I $\pi N \rightarrow Ne^-e^+$ PO DANNYM OPYTA]
A. V. Tarasov 1966 11 p refs In RUSSIAN
(JINR-P2-3062)

A scheme is given of a complete experiment for the processes $eN \rightarrow eN\pi$ and $\pi N \rightarrow Ne^-e^+$. The formulas are obtained which express the amplitudes, describing the above-mentioned processes, by the measured values. Author (NSA)

N67-23562# Bettis Atomic Power Lab., Pittsburgh, Pa.
VARIATIONAL PRINCIPLE FOR THE NEUTRON DIFFUSION EQUATION USING DISCONTINUOUS TRIAL FUNCTIONS
A. J. Buslik Oct. 1966 20 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-610) CFSTI: HC $3.00/MF $0.65

A variational principle for the neutron diffusion equation which permits the use of discontinuous trial fluxes is presented. The principle is based on the method of Lagrange multipliers. Applications of the principle to problems of axial synthesis are given, and the principle is compared to that of Selengut and Wachspress. Author (NSA)

N67-23563# Bettis Atomic Power Lab., Pittsburgh, Pa.
DIFFERENCE EQUATIONS FOR THE NEUTRON DIFFUSION EQUATIONS IN HEXAGONAL GEOMETRY
R. B. Kellogg Oct. 1966 38 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-645) CFSTI: HC $3.00/MF $0.65

The difference equations used in the hexagonal geometry option of the PDQ-7 program are derived. These difference equations are interpreted as belonging to a whole family of hexagonal difference approximations which in turn are derived using discontinuous trial functions. The truncation error of the PDQ-7 hexagonal difference equations is also discussed. Author (NSA)

N67-23564# Bettis Atomic Power Lab., Pittsburgh, Pa.
A SIMPLE METHOD TO IMPROVE THE EFFICIENCY OF THE Σ_a/Σ_t ESTIMATOR IN CERTAIN MONTE CARLO PROGRAMS
N. M. Steen Oct. 1966 13 p ref
(Contract AT(11-1)-GEN-14)
(WAPD)-TM-609) CFSTI: HC $3.00/MF $0.65

The Σ_a/Σ_t estimator (often used in Monte Carlo programs to estimate neutron capture rates in assemblies or reactor materials) is inefficient in regions having a high probability of neutron entry but a low collision probability. A simple method is described to enhance the efficiency of this estimator in such regions by fictitiously increasing the optical thickness. Proof is given that this method will not bias the capture estimates or the flux, and examples are provided to show the improvement that may be achieved. Author (NSA)

N67-23565# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ELECTRON SCATTERING BY POLARIZED HADRON TARGETS [RASSEYANIE ELEKTRONOV NA POLYARIZOVANNYKH ADRONNYKH MISHENYAKH]
V. M. Dubovik and A. A. Cheshkov 1966 19 p refs In RUSSIAN
(JINR-P2-2991) CFSTI: HC $3.00/MF $0.65

The cross section for electron–hadron scattering $e+N \rightarrow e+N'$ is calculated in the one–photon approximation. It is supposed that the target particle N has spin j and mass κ and a newly produced particle N'–spin j and mass κ'. All transition electromagnetic form factors are taken into account. The spin state of target particles is considered to be arbitrary and expressed in terms of the density matrix in the form of an expansion in irreducible spherical tensors. The electron rules of form factors are given under P– and T–invariance requirements. The contribution of T–noninvariant form factors to the cross section is discussed. Some important particular cases are obtained from the general cross section formula. Author (NSA)

N67-23568# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
INTERACTION OF A NUCLEON ON AN ISOLATED LEVEL WITH A QUADRUPOLE PHONON [VZAIMODEISTVIE NUKLONA NA IZOLIROVANNOM UROVNE S KVADRUPOL'NYM FONONOM]
R. V. Dzholos 1966 14 p refs In RUSSIAN
(JINR-P4-2985) CFSTI: HC $3.00/MF $0.65

A method is suggested for an approximate treating of the nucleon–phonon interaction, by the example of a simple model in which a nucleon interacts on an isolated level with a quadrupole phonon. This method is used to investigate different solutions which were obtained earlier by other authors. It is shown that not all of these solutions are correct. Author (NSA)

N67-23569# Franklin Inst., Swarthmore, Pa.
STUDIES OF ELECTROMAGNETIC PROPERTIES OF EXCITED STATES OF NUCLEI Annual Progress Report, 1966
F. R. Metzger 12 Dec. 1966 19 p refs
(Contract AT(30-1)-3525)
(NYO-3525-12) CFSTI: HC $3.00/MF $0.65

Nuclei recoiling after radioactive decays or as a result of nuclear reactions, or nuclei moving at the high velocities available in the Bartol High Speed Rotor Facility, provided the resonant gamma rays for resonance fluorescence experiments with ^{40}Ca, ^{42}CA, ^{46}Ti, ^{75}As, ^{185}Re, ^{187}Re, ^{191}Ir, and ^{193}Ir. In addition to determining absolute electromagnetic transition strengths and multipole mixing amplitudes, these experiments established previously unknown levels in ^{185}Re, ^{191}Ir, and ^{193}Ir, and led to unambiguous spin assignments for some other levels. Theoretical investigations included the evaluation of the spreading width of analog states which results from the Coulomb interactions in a nucleus. A study of the fine structure of analog states was also made, with particular emphasis on the understanding of the disappearance of the fine-structure strength at a certain point in the spectrum. Particle-hole calculations in nuclei in the mass region A=90 were carried out. The properties of isospin T=2 and T=3/2 states in the A=16 region were investigated, and a variational calculation of the deformation of the nucleus C^{12} was performed. Author (NSA)

N67-23570# Texas Nuclear Corp., Austin.
TRNRX: A FORTRAN PROGRAM FOR GAMMA RAY ANGULAR DISTRIBUTIONS IN (n,n'γ) REACTIONS WITH MOLDAUER'S FLUCTUATION CORRECTIONS
S. C. Mathur, P. S. Buchanan, and I. L. Morgan Aug. 1966 52 p refs
(Contract AT(40-1)-2791)
(ORO-2791-20) CFSTI: HC $3.00/MF $0.65

A computer program (TRNRX) for the calculation of gamma angular distribution and production cross sections for neutron inelastic scattering, taking into account Moldauer's width fluctuation corrections, is described. NSA

N67-23571# Polish Academy of Sciences, Cracow.
TOTAL REACTION CROSS-SECTION FOR 24.7 MeV α PARTICLES IN THE REGION OF A=60 NUCLEI
Andrzej Budzanowski, Kazimierz Grotowski, J. Kuzminski, Henryk Niewodniczanski, Adam Strzalkowski et al Oct. 1966 7 p refs Presented at the Intern. Conf. on Nucl. Phys., Gatlinburg, Tenn., 1966
(INP-503/PL) CFSTI: HC $3.00/MF $0.65

Total reaction cross sections for the interaction of alpha particles of the energy 24.7 MeV with Cr, Fe, Ni, Co, Cu, and Zn nuclei were measured by the transmission method. A good overall agreement with the predictions of the optical model was obtained with exception of Ni nuclei where the experimental value of the cross section is definitely lower than the theoretical value. Author (NSA)

N67-23572# Pittsburgh Univ., Pa. Wherrett Lab. of Nuclear Chemistry.
NUCLEAR CHEMISTRY RESEARCH: RECOIL STUDIES OF NUCLEAR REACTIONS Annual Report, Jan. 1966–Jan. 1967
Robert L. Wolke Jan. 1967 76 p refs
(Contract AT(30-1)-2771)
(NYO-2771-19) CFSTI: HC $3.00/MF $0.65

The compound-statistical features of deuteron-induced reactions were studied further. The cross section of the $^{65}Cu(d,2p)^{65}Ni$ reaction was measured using 12-MeV deuterons, and a computer program was written for statistical-model evaporation calculations. In addition, absolute cross sections and isomeric yields ratios for (d,p) reactions on ^{114}Cd, ^{133}Cs, ^{59}Co, ^{110}Pd, ^{196}Pt, ^{187}Re, ^{103}Rh, ^{181}Ta, and ^{89}Y between 4 and 15 MeV were measured; a comparison was made with production of the same isomer pairs by the (n,γ) reaction. Isomer ratios were also calculated by various approaches and were compared with the experimental results. Film densitometry of internal conversion electron lines was also investigated. An angular anisotropy of the 118- and 306-keV gamma rays from ^{48}Cr was observed, and preliminary measurements of recoil angular distributions from the reactions $^{6}Li(d,n)^{7}Be$, $^{197}Au(d,p)^{198}Au$, $^{197}Au(d,2n)^{197}Hg$, and $^{197}Au(d,t)^{196}Au$ were made. NSA

N67-23573# Polish Academy of Science, Cracow.
RESONANCE IN THE ELASTIC SCATTERING OF ALPHA PARTICLES ON ^{40}Ca NUCLEI
Andrzej Budzanowski, Kazimierz Grotowski, Lucjan Jarczyk, Henryk Niewodniczanski, and Adam Strzalkowski Oct. 1966 5 p refs Presented at the Intern. Conf. on Nucl. Phys., Gatlinburg, Tenn., Sep. 1966
(INP-502/PL; CONF-660906-45) CFSTI: HC $3.00/MF $0.65

The experimental data on angular distributions for the elastic scattering of alpha particles on ^{40}Ca nuclei at different energies from 23.37 to 28.92 MeV were analyzed using the optical model. No satisfactory fits were obtained. The agreement could be considerably improved by modifying the phase shifts for the J=10 partial waves. Evidence for a resonance at the energy of 24.4 MeV is presented. Author (NSA)

N67-23574# Polish Academy of Sciences, Cracow.
LEVEL STRUCTURE OF ^{48}Sc FROM THE $^{50}Ti(d,\alpha)^{48}Sc$ REACTION
Kazimierz Grotowski, Stefan Wiktor, and Fausto Pellegrini (Padua Univ.) Oct. 1966 14 p refs Submitted for publication
(INP-491/PL) CFSTI: HC $3.00/MF $0.65

The $^{50}Ti(d,\alpha)^{48}Sc$ reaction was investigated using deuterons with an energy of 12.9 MeV. The energy spectra and angular distributions of α particles emitted in this reaction were measured. Relatively large cross sections were found for transitions leading to the 0.14; 1.06; and 2.03-MeV excited states of the residual ^{48}Sc nucleus. The spin and parity values suggested for the 0.14-MeV state and the previously unobserved 1.06-MeV state are $J^{\pi}=5^{+}$ and $J^{\pi}=7^{+}$ respectively. Author (NSA)

N67-23575# Oak Ridge National Lab., Tenn.
DEVELOPMENT OF STOCK-CAR COMPUTER PROGRAM FOR FLUX AND DOSE DUE TO A SOLID OR TORIC CYLINDRICAL SOURCE
Bernadette Daversin (Comm. a l'Energie Atomique, Fontenay-aux-Roses (France)). Dec. 1965 10 p Transl. into ENGLISH from the French Report CEA-N-575
(ORNL-TR-1372; CEA-N-575) CFSTI: HC $3.00/MF $0.65

A computer program for the calculation of the flux, the energy flow, and the radiation dose due to a solid or toric cylindrical source at a point on a horizontal axis passing through the lower base of the cylinder is described. NSA

N67-23576# Bettis Atomic Power Lab., Pittsburgh, Pa.
A METHOD OF INCLUDING EPITHERMAL NEUTRON SCATTERING BY BOUND PROTONS IN COMBINED-DOWN/THERMAL CALCULATIONS BY MONTE CARLO

N. R. Candelore and R. C. Gast Oct. 1966 14 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-617) CFSTI: HC$3.00/MF$0.65

A method of including epithermal neutron scattering by bound protons in combined slowing down-thermal calculations by the Monte Carlo method is suggested by the theoretical work of Corngold. A comparison of experiments and calculations using this method reveals that it is sufficient to account for epithermal binding effects in H_2O as reflected in the epithermal flux and in the detailed slowing-in-source to thermal energy. Author (NSA)

N67-23577# Atomic Energy Commission, Oak Ridge, Tenn.
CINDA: AN INDEX TO THE LITERATURE ON MICROSCOPIC NEUTRON DATA, SUPPLEMENT 1
15 Oct. 1966 327 p Prepared in cooperation with ENEA Neutron Data Compilation Centre, Gif-sur-Yvette (France).
(TID-23357, Suppl. 1) CFSTI: HC$3.00/MF$0.65

A compilation of all the additions entered into the CINDA master library tape between July 1, 1966 and Oct. 15, 1966 is presented. Corrections and improvements to previous entries are included. NSA

N67-23578# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
NEUTRINO INTERACTIONS WITH RELATIVISTIC ELECTRONS [VZAIMODEISTVIE NEITRINO S RELYATIVISTSKIMI ELEKTRONAMI]
A. Vanzha and L. Lapidus 1966 11 p refs In RUSSIAN
(JINR-P-2779) CFSTI: HC$3.00/MF$0.65

The narrowing effect of the neutrino during interactions with relativistic electrons, leading to elastic scattering and to transformation into pairs of $\mu+\nu_\mu$ was examined. The V–A theory leads to the fact that in processes of electron–neutrino interactions with electrons, the energy spectrum is uniform. In processes of antineutrino–electron interactions the mean energy of the neutrino after interaction is close to 1/4 of the energy of the relativistic electron in the initial state. Author (NSA)

N67-23579# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
DEGENERATE UNITARY REPRESENTATIONS OF THE SU(2,2) GROUP AND ELEMENTARY PARTICLE SYMMETRY [VYROZHDENNYE UNITARNYE PREDSTAVLENIYA GRUPPY SU(2,2) I SIMMETRIYA ELEMENTARNYKH CHASTITS]
Cao Chi 1966 14 p refs In RUSSIAN
(JINR-P2-3078) CFSTI: HC$3.00/MF$0.65

Two series of degenerate unitary representations of the SU (2,2) group were found previously. It is proved that one of these two series (the principal one) belongs to the so called Graev d_1 series. Besides, a possible application of the principal series representations to the elementary particle symmetry theory is pointed out. The $SU(2,2)\ |SU(2)\times SU(2)\times U(1)|_p$ reduction is given where p is four-momentum of particle. Particles are classified according to irreducible representations of the maximal compact subgroup. The vertex of interaction of an infinite multiplet with a scalar external field is briefly considered. Author (NSA)

N67-23580# Muenster Univ. (West Germany). Inst. fuer Theoretische Physik.
LEE MODEL WITH COULOMB INTERACTION [LEE-MODELL MIT COULOMB-WECHSELWIRKUNG]
H. Hannover Jul. 1966 8 p refs
(BMwF-FBK-66-22) CFSTI: HC$3.00/MF$0.65

The Hamiltonian of the Lee model in the sector (1,0) with an additional $N\theta$-interaction is diagonalized by means of Green's operator $(E-H)^{-1}$. In addition to a continuous spectrum of scattering states one gets a discrete spectrum consisting of a ground-state level determined essentially by Lee's interaction H_1, and excited states generated by the additional interaction H_2. The effect on the time law of decay of choosing various density matrices describing unstable particles is briefly discussed. Author (NSA)

N67-23582# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
DISPERSION SUM RULES AND HIGH ENERGY SCATTERING
A. A. Logunov, L. D. Soloviev, and A. N. Tavkhelidze 1966 6 p ref
(JINR-E2-3077) CFSTI: HC$3.00/MF$0.65

Dispersion sum rules which connect the high-energy scattering parameters with the integrals of low-energy cross-sections are obtained. Author (NSA)

N67-23584# Case Inst. of Tech., Cleveland, Ohio. Dept. of Physics.
NEUTRON TOTAL CROSS SECTION MEASUREMENTS USING A "WHITE" NEUTRON SOURCE
L. A. Galloway, III and E. F. Shrader Sep. 1966 131 p refs
(Contract AT(11-1)-1573)
(COO-1573-6) CFSTI: HC$3.00/MF$0.65

A method for measuring neutron total cross sections using a neutron intensity spectrum continuous in energy (a "white" spectrum) and a pulsed beam time-of-flight technique is used to measure neutron total cross sections in the 2 to 10 MeV region. Total cross sections for the elements Mg, Al, Ca, V, Fe, Pd, Ag and Pb were measured to 1% average uncertainty in steps of 0.08 ns/m. Energy resolution varied from about 1.5% at 2 MeV to 3% at 10 MeV. Results of these measurements are compared with measurements on the same samples with neutrons of known energy and with measurements of other workers. Author (NSA)

N67-23585# Iowa State Univ. of Science and Technology, Ames.
RELATIVISTIC ENERGY BANDS AND FERMI SURFACES FOR SOME HEAVY ELEMENTS
Stewart Charles Keeton (Ph.D. Thesis) Nov. 1966 126 p refs
(Contract W-7405-ENG-82)
(IS-T-109) CFSTI: HC$3.00/MF$0.65

A theoretical investigation is presented of the relativistic effects on the band structure of heavy metals, i.e., metals composed of heavy elements. The theoretical method used in the calculations was the relativistic augmented-plane-wave method. Relativistic and nonrelativistic energy bands are compared for Lu, Ac, and Th. The relativistic effects are particularly striking for Ac and Th. One relativistic effect that is quite apparent from the energy bands presented here is the tighter binding of the atomic electrons with low angular momentum. This has the effect of moving the s-like band in Ac and Th down by about .2 Rydberg at the center of the Brillouin zone. The energy bands and Fermi surfaces of Hg, Th, and Dy are also presented. Available experimental de Haas–van Alphen and magnetoresistance data are compared with theoretical predictions calculated for Hg. The agreement is good. The experimental density of states at the Fermi level obtained from specific heat and magnetic susceptibility measurements for Th are compared with the calculated value for Th found in this investigation. The agreement implies that electron–phonon and electron–electron interactions may be unimportant for Th. Theoretical predictions are also presented for de Haas–van Alphen frequencies and cyclotron effective masses for Th. The calculated Fermi surface for Dy implies that the shape of this surface is such as to favor an antiferromagnetic superlattice. The predicted periodicity of this antiferromagnetic structure agrees with the values obtained from neutron diffraction experiments. Author (NSA)

N67-23597# Iowa State Univ. of Science and Technology, Ames.
DOUBLE PION PRODUCTION WITHOUT ANNIHILATION IN ANTIPROTON–PROTON INTERACTIONS AT 2.7 GeV/c
Henry Bert Crawley (Ph.D. Thesis) Nov. 1966 64 p refs
(Contract W-7405-ENG-42)
(IS-T-127) CFSTI: HC $3.00/MF $0.65

A study was made of the reaction $\bar{p}p \rightarrow \bar{p}p\pi^+\pi^-$ at an incident antiproton momentum of 2.7 BeV/c. The total cross section for this reaction was determined to be 1.93 ± 0.16 mb. The data were found to be consistent with 100% $N^*\bar{N}^*$ formation where N^* is the pion–nucleon resonance with $T = T_z = J = 3/2$, central mass value 1238 MeV, and width 125 MeV. It was observed that the $\bar{N}^*$ production is highly peripheral; that is, in the over-all center of mass system more than 50% of the $\bar{N}^*$'s are produced with a production angle whose cosine is greater than 0.8. A comparison of the data with the predictions of the form-factor and absorption one-pion-exchange models was made. For the form-factor model only the contribution from the double-isobar diagram was included, as modified by the form-factor and off-shell corrections given by Selleri. The $T_z = 1/2$ diagram was excluded because it is predicted to contribute only 1% of that of the double-isobar diagram. Finally, the contribution from the Drell diagrams was excluded on empirical grounds, since the Drell diagrams contribute to zero or single resonance production, and the data are consistent with 100% double resonance formation. For the absorption model the predictions supplied by Hite and Jackson were compared with the data. It is found that both models account for the peripherality of the $\bar{N}^*$ production and for the effective mass distribution, but that neither model is successful in explaining the decay angular distributions. Author (NSA)

N67-23598# Pennsylvania Univ., Philadelphia.
BACKWARD πp SCATTERING
W. Selove Aug. 1966 28 p refs Presented at the Intern. Conf. on Two-Body Problems at High Energy, Stony Brook, N. Y., Apr. 1966
(Contract AT(30-1)-2171)
(NYO-2171-219; CONF-660420-3) CFSTI: HC $3.00/MF $0.65

Measurement of the differential cross section is reported for elastic scattering of positive and negative π mesons from hydrogen at 4 to 8 GeV/c, around 180° c.m.s., corresponding to a range of U (square of the four-momentum transfer from incoming pion to outgoing proton) from 0.1 to -1.0 $(GeV/c)^2$. NSA

N67-23599# Oak Ridge National Lab., Tenn.
SHELL MODEL CALCULATIONS OF NUCLEI FROM A = 6 TO 45 USING THE HAMADA–JOHNSTON POTENTIAL
E. C. Halbert, Y. E. Kim, J. B. McGrory, and T. T. S. Kuo (Princeton Univ.) Sep. 1966 10 p refs Presented at the Intern. Conf. on Nuclear Phys., Gatlinburg, Tenn., 12–17 Sep. 1966
(Contract AT(30-1)-937)
(PUC-937-233; CONF-660906-46) CFSTI: HC $3.00/MF $0.65

An effective interaction obtained from the Hamada–Johnston potential is used to calculate shell-model spectra of nuclei with A = 6 to 45. In some of these cases, core-polarization effects are introduced through a renormalization of the interaction. Some electromagnetic moments and transitions of p-shell nuclei are calculated. In general, the results throughout this region are encouraging. Author (NSA)

N67-23623# American Meteorological Society, Boston, Mass.
THEORETICAL DETERMINATION OF THE MAGNETIC SUSCEPTIBILITY OF LIGHT ATOMS [K TEORETICHES-KOMU OPREDELENIIU MAGNITNOI VOSPRIIMCHIVOSTI LEGKIKH ATOMOV]
E. V. Mauza, Io. I. Vizbaraite, and A. P. Iutsis Nov. 1966 19 p refs Transl. into ENGLISH from TR. Akad. Nauk Lit. SSR, Ser. B. (Vilna), v. 2, no. 18, 1959 p 41–51
(Contract AF 19(628)-3880)
(T-R-601; AD-645512) CFSTI: HC $3.00/MF $0.65

A refined method of calculation that includes both the multi-configuration approximation and the method of partial separation of variables in the approximation of the two-electron-state model is applied to the theoretical determination of magnetic susceptibility. The authors present and discuss a number of numerical results for atoms (ions) of helium type, beginning with H^- and ending with C^{4+}, and of beryllium type, beginning with Li^+ and ending with C^{2+}. TAB

N67-23635# Air Force Cambridge Research Labs., Bedford, Mass. Solid State Sciences Lab.
THE POWER LAW AND CONSTANT LOSS MODELS IN SECONDARY ELECTRON EMISSION
Peter D. Gianino and Edward A. Burke Oct. 1966 28 p refs /ts Phys. Sci. Res. Papers, No. 277
(AFCRL-66-697; AD-645465) CFSTI: HC $3.00/MF $0.65

There is evidence that the low-energy component of secondary emission from metals under relativistic electron bombardment can be predicted using experimental data obtained under low-energy irradiation. This greatly enhances the motivation for establishing a model applicable to low-energy bombardment which can reliably predict the behavior of all necessary quantities. Two phenomenological models - namely, the Power Law (P.L) and the Constant Loss (C. L) assumptions - have already been employed in this energy range. This report presents a more comprehensive and conclusive treatment of both assumptions with the ultimate aim of deciding which is the more suitable. It includes, for both suppositions, the derivation of all pertinent equations, including the ratio E/delta x; the furnishing of many more equivalent expressions for the maximum total yield; and the reduction of the equations for total yields at moderately high energies to a form identical with that used successfully at relativistic energies for the low-energy component from thin targets. When the reduced yields of both models are compared with that of empirical data, results indicate that the P. L. model with $n = 1.35$ provides a more satisfactory fit. Further examination shows that the parameter A appears to be a fixed constant, not a characteristic of each material, and the total yields and energies in the moderately high range in the P. L. determination of E/delta x are interchangeable with the maximum total yield and its corresponding energy. Author (TAB)

N67-23698# North Carolina State Coll., Raleigh. Dept. of Nuclear Engineering.
THE EFFECT OF RADIATION AND GAS CONCENTRATION ON RARE GAS DIFFUSION IN SOLIDS Annual Progress Report, 1 Mar.–7 Nov. 1966
Thomas S. Elleman 7 Nov. 1966 31 p refs
(Contract AT(40-1)-3508)
(ORO-3508-1) CFSTI: HC $3.00/MF $0.65

Techniques for preparing single crystals of CsI doped with radioactive ^{133}I were developed, and a number of tagged crystals were prepared. Following decay of ^{133}I to radioactive ^{133}Xe, crystals were heated at temperatures ranging from 200 to 500°C and the rate of gas release measured by assay of the ^{133}Xe outside the specimens. The kinetics of gas release agreed with classical diffusion mechanisms, and a single activation energy for diffusion of 23 kcal/mole was observed. Crystals grown rapidly yielded X-ray diffraction patterns showing high internal stresses, and these crystals yielded the burst type gas diffusion behavior characteristically observed in fission gas release studies with reactor fuels. The true diffusion coefficient for these crystals was identified with the initial rapid release during the burst rather than with the slower gas release at long heating times. Preliminary experiments where the ^{133}Xe was produced by fast neutron transmutation of ^{133}Cs also gave classical diffusion kinetics, but the diffusion coefficients were lower than those obtained in the ^{133}I doping experiments. Results to date are consistent with a model where gas atoms are trapped during diffusion at defects produced during crystal growth or fast neutron irradiation and later released from the defects to diffuse through the lattice. Author (NSA)

N67-23717*# Ling-Temco-Vought, Inc., Dallas, Tex.
ELECTRON SCATTERING AND BREMSSTRAHLUNG CROSS-SECTION MEASUREMENTS
D. H. Rester and W. E. Dance Washington, NASA, Apr. 1967 57 p refs
(Contract NASw-1385)
(NASA-CR-759) CFSTI: HC$3.00/MF$0.65 CSCL 20H

Measurements of the cross sections for Coulomb scattering of electrons without atomic excitation by Al and of the electron penetration spectra due to bombardment of thick Al slabs were previously reported. The present report contains the results of additional thick target transmission measurements on Al, thick target transmission measurements on Au, and electron backscattering measurements on targets of Al, Fe, Sn, and Au. Where the data is available comparisons are made to Monte Carlo calculations. Author

N67-23722# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
SPECTRA AND ANGULAR DISTRIBUTIONS OF α PARTICLES FROM THE INTERACTIONS OF ACCELERATED ^{22}Ne AND Ar IONS WITH Au AND Th NUCLEI [SPEKTRY I UGLOVYE RASPREDELENIYA α-CHASTITS OT VZAIMODEISTVIYA USKORENNYKH IONOV ^{22}Ne, ^{40}Ar S YADRAMI Au, Th]
A. Kapustsik, V. P. Perelygin, S. P. Tret'yakova, and L. V. Ukraintseva 1966 23 p refs In RUSSIAN
(JINR-P7-3041) CFSTI: HC$3.00/MF$0.65

Spectra and angular distributions of α particles from the interaction of ^{22}Ne ions with Au nuclei at 110 and 120 MeV and with Th nuclei at 115 and 140 MeV, as well as from the interaction of ^{40}Ar ions with Th nuclei at 240 MeV, were measured. In the spectra and angular distributions of the α particles one can clearly distinguish between the components corresponding to evaporation from the compound nucleus and direct processes. Author (NSA)

N67-23723# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
ISOMERIC CROSS SECTION RATIOS IN NUCLEAR REACTION LEADING TO ^{190}Ir, ^{198}Au, AND ^{242}Am [IZOMERNYE OTNOSHENIYA V YADERNYKH REAKTSIYAKH PRIVODYASHCHIKH K IZOTOPAM ^{190}Ir, ^{198}Au, I ^{242}Am]
G. N. Flerov, Yu. P. Gangrskii, B. N. Markov, A. A. Pleve, S. M. Polikanov et al 1966 13 p refs In RUSSIAN
(JINR-P7-3065) CFSTI: HC$3.00/MF$0.65

Isomeric cross section ratios in nuclear reactions leading to ^{190}Ir, ^{198}Au, and ^{242}Am were investigated. The dependences of these ratios on the average angular momentum were obtained. It is concluded that the spin of the spontaneously fissionable isomer ^{242}Am is small. Author (NSA)

N67-23742# California Univ., Davis. Crocker Nuclear Lab.
[NUCLEAR PHYSICS] Annual Report
John A. Jungerman and William W. True 22 Aug. 1966 47 p refs
(Contract AT(11-1)-GEN-10)
(UCD-CNL-67) CFSTI: HC$3.00/MF$0.65

Energy levels of ^{145}Sm were investigated by the decay of ^{145}Eu using a Ge(Li) spectrometer. The ^{145}Eu was produced with a 22-in. cyclotron by proton bombardment of ^{144}Sm. The level scheme and gamma transitions observed are presented. A study was begun on the decay of ^{211}Pb to ^{211}Bi in the interest of determining the spins of the 832 and 1104 keV states in ^{211}Bi. The NaI singles spectrum and the NaI coincidence spectrum gated by the 405 keV line is given for ^{211}Bi. NSA

N67-23743# Princeton Univ., N.J. Plasma Physics Lab.
ENTROPY PRINCIPLE FOR THE DERIVATION OF A NEW CLUSTER EXPANSION
J. M. Dawson, M. D. Kruskal, and G. V. Ramanthan Sep. 1966 12 p refs
(Contracts AT(30-1)-1480; AF 49(638)-1555)
(TID-23497; PPL-AF-10) CFSTI: HC$3.00/MF$0.65

A product expansion for the s-particle distribution function (s arbitrary) is derived by means of a variational principle involving the entropy associated with the (s+1) particle distribution function. Author (NSA)

N67-23747# Joint Inst. for Nuclear Research, Dubna (USSR).
METHOD FOR EXPERIMENTAL DATA PROCESSING BY USING NORMAL LAW SUPERPOSITION [METOD OBRABOTKI EKSPERIMENTAL'NYKH DANNYKH S POMOSHCH'YU SUPERPOZITSII NORMAL'NYKH ZAKONOV]
A. M. Kosareva, G. A. Osokov, and K. D. Tolstov [1966] 13 p refs In RUSSIAN
(JINR-P10-3032) CFSTI: HC$3.00/MF$0.65

A method is given for experimental data processing taking account of measurements performed with different accuracy. Probability densities of components of a desired random variable are decomposed into a normal law superposition. The number of terms of decomposition and the density parameters are estimated by the least squares method. The above method is applied to the calculation of the probability density of the transverse momentum in inelastic π^-–p collisions at 7 GeV/c. Author (NSA)

N67-23748# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
INVESTIGATION OF THE REACTION $\pi^-+p\to\pi^-+p+m\gamma$ ($m\leq1$) AT A π^- MESON MOMENTUM OF 4 GeV/c [ISSLEDOVANIE REAKTSII $\pi^-+p\geq\pi^-+m\gamma$ ($m<1$) PRI IMPUL'SE π^-–MEZONOV 4 GeV/c]
V. B. Lyubimov and V. N. Streltsov [1966] 10 p refs In RUSSIAN
(JINR-P1-3088) CFSTI: HC$3.00/MF$0.65

Interactions when at least one visible γ quantum is emitted, are investigated using the photographs from a 24-liter propane bubble chamber bombarded with the negative pions of (3.97±0.06) GeV/c momentum. The results are given of the analysis of 498 two-prong events which have the secondary proton with the momentum (lcm) from 180 to 500 MeV/c. Author (NSA)

N67-23749# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
CP-VIOLATION IN WEAK ELECTROMAGNETIC INTERACTIONS AND $K_L\to\pi^+\pi^-$–DECAY [NARUSHENIE CP–INVARIANTNOSTI V SLABOELEKTROMAGNITNYKH VZAIMODEISTVIYAKH I RASPAN $K_L\to\pi^-\pi^+$]
B. A. Arbuzov and A. T. Filippov [1966] 5 p refs In RUSSIAN
(JINR-P2-3067) CFSTI: HC$3.00/MF$0.65

P-invariant modification of the previously proposed CP-violating mechanism in coupling of spinor particles with photons is considered. The interaction may occur on the electromagnetic or weak-electromagnetic level. It is shown that in the latter case the parameters of nonradiative decays in the $K^0-\bar{K}^0$ system are the same as the ones in the model of superweak CP-violating interaction. Author (NSA)

N67-23750# United Kingdom Atomic Energy Authority, Harwell (England).
POLARIZED PROTON TARGET FOR PROTON SCATTERING EXPERIMENTS
T. W. P. Brogden Dec. 1966 26 p refs
(AERE-R-5328) HMSO: 4s

The design and construction are described of a polarized hydrogen target for use in spin correlation studies with incident protons of energies between 70 and 150 MeV. The "solid effect" in lanthanum magnesium nitrate doped with neodymium provided the polarization mechanism in the target. The problems associated with the microwave cavity enclosing the target, especially its cooling requirements, are discussed in detail. Operating experience showed that the target was reasonably convenient and reliable, giving target polarizations of 0.30 to 0.35. Radiation damage in the target crystal due to the incident beam was found to set in very rapidly. Author (NSA)

N67-23751# Bundesministerium fuer Wissenschaftliche Forschung, Bad Godesberg (West Germany).
EXCITATION FUNCTIONS AND ANGULAR DISTRIBUTIONS OF THE REACTION $^{7}Li(p,\gamma)^{8}Be$ [ANREGUNGSFUNKTIONEN UND WINKELVERTEILUNGEN DER REAKTION $^{7}Li(p,\gamma)^{8}Be$]
V. Riech Jul. 1966 28 p refs In GERMAN
(BMwF-FBK-66-26) CFSTI: HC$3.00/MF$0.65

Excitation functions and angular distributions of both γ transitions of the reaction $^{7}Li(p,\gamma)^{8}Be$ were measured separately for proton energies between 0.8 and 3.1 MeV. To specify the spin and parity of the 19.06-MeV level in ^{8}Be, the energy dependence of the coefficients of the angular distributions and the excitation functions were calculated by superposition of three ^{8}Be levels over the nonresonant cross section due to the El giant resonance. The assignment of $J^{\pi}=3^{-}$ was confirmed. Author (NSA)

N67-23752# Soreq Research Establishment, Israel Atomic Energy Commission, Yavneh.
BASIC NUCLEAR DATA FOR THE HIGH PLUTONIUM ISOTOPES. PART I: CROSS SECTIONS
M. Segev, M. Caner, and S. Yiftah Jun. 1966 27 p refs
(IA-1094) CFSTI: HC$3.00/MF$0.65

Energy-dependent cross sections of ^{240}Pu, ^{241}Pu, and ^{242}Pu, in the range from 1 keV to 15 MeV, are constructed from the scant available experimental data by interpolation, extrapolation, general theoretical arguments and systematics. The constructed gross sections are presented in graphical form in 14 figures. Author (NSA)

N67-23753# Commissariat a l'Energie Atomique, Grenoble (France). Nuclear Studies Center.
TWO-BODY INTERACTION IN THE REACTION $^{9}Be(n,nn)\alpha\alpha$ AT 14 MeV. I: EXISTENCE OF RESONATING STATES [INTERACTIONS A DEUX CORPS DANS LA REACTION $^{9}Be(n,nn)\alpha\alpha$ A 14 MeV. I: MISE EN EVIDENCE DES ETATS RESONNANTS]
Claude Perrin (Ph.D. Thesis—Grenoble Univ.) Sep. 1966 40 p refs In FRENCH
(CEA-R-2985) CFSTI: HC$3.00/MF$0.65

The basic mechanisms of the reaction $^{9}Be(n,nn)\alpha\alpha$ were studied together with their application to an experiment in which the two impulse vectors of the neutrons are measured. Kinematic and phase-space calculations were performed. An analysis of groups of events (n,2n) observed in the (T_1,T_2) plot shows a sequence of two-body interactions: inelastic scattering by $^{9}Be(n,n')$ followed by emission of neutrons $^{9}Be^{*} \rightarrow {}^{8}Be^{*}+n$ of the decay of the (6.76–7.94–9.1 MeV) levels of ^{9}Be to ^{8}Be in the (0+) and (2+) states. Author (NSA)

N67-23755# California Univ., Berkeley. Lawrence Radiation Lab.
THE MAGNETIC MOMENT OF ^{239}Pu
John Faust (Ph.D. Thesis) 4 Aug. 1966 63 p refs
(Contract W-7405-ENG-48)
(UCRL-16999) CFSTI: HC$3.00/MF$0.65

The triple-loop technique of atomic-beam magnetic resonance was used to determine the magnetic moment of ^{239}Pu directly. The final measurement was carried out at a magnetic field of 720 gauss and the magnetic moment was found to be $\mu_I = +0.200(4)$ nm (corrected), where the sign is measured to be positive. Hyperfine-structure measurements on ^{241}Pu, ^{185}W, and ^{187}W were attempted. These experiments involved the observation of four- and six-quantum transitions because of the inverted level ordering which was caused by the unusually large values of the quadrupole moments of all of these isotopes. Author (NSA)

N67-23756# Bettis Atomic Power Lab., Pittsburgh, Pa.
TEST OF THE TIME SYNTHESIS APPROACH FOR THE SOLUTION OF REACTOR KINETICS PROBLEMS
J. A. Bewick and S. Kaplan Oct. 1966 33 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-641) CFSTI: HC$3.00/MF$0.65

A series of numerical experiments are reported in which time dependent diffusion problems are solved approximately by various versions of the modal analysis and time synthesis methods. Author (NSA)

N67-23763# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
SPIN–QUADRUPOLE FORCES AND COLLECTIVE STATES IN DEFORMED NUCLEI. I: 0^{+} STATES
M. I. Chernej, N. I. Pyatov, and K. M. Zheleznova 1966 28 p refs
(JINR-E4-3025) CFSTI: HC$3.00/MF$0.65

The residual spin–quadrupole interaction effects in collective motion of deformed nuclei are considered. An equation for the energy of 0^{+} and 2^{+} collective states is derived using the approximate second quantization method. Pairing and quadrupole as well as spin–quadrupole interactions are taken into account. The appearance of a new branch of collective excitations below the two-quasi-particle energy is predicted. The decay properties and the structure of the collective states are studied. The energies and E2 transition probabilities for 0^{+} states are calculated for nuclei in the region $150 \leq A \leq 174$. Author (NSA)

N67-23764# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
INVESTIGATION OF THE DIFFUSION OF THE NUCLEAR REACTION RECOIL PRODUCTS IN METALS AND OXIDES [ISSLEDOVANIE DIFFUZII PRODUKTOV YADERNYKH REAKTSII V METALLAKH I OKISLAKH]
B. Amov, V. P. Permyakov, and N. I. Tarantin 1966 14 p refs In RUSSIAN
(JINR-P13-3019) CFSTI: HC$3.00/MF$0.65

Emission and thermoionization characteristics of different oxide compounds and of some metals caused by nuclear recoil products trapped into them were investigated. The experiments were carried out to choose emitters or thermoionizers for ion sources of on-line electromagnetic seperators. Author (NSA)

N67-23767# Joint Inst. for Nuclear Research, Dubna (USSR).
ON A REJECTION OF POORLY MEASURED TRACK POINTS [K VOPROSU O VYBROSE PLOKHO IZMERENNYKH TOCHEK NA TREKAKH POLUCHAEMYKH V PUZYR'KOVOI PROPANOVOI KAMERE]
Ya. Benshova, I. Vrana, and I. Marek 1966 7 p In RUSSIAN
(JINR-P10-3023) CFSTI: HC$3.00/MF$0.65

A new method to reject poorly measured track points is suggested for a geometric track reconstruction in bubble chambers. The circle arc is laid through the measured points by the least squares method. Author (NSA)

N67-23768# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.

A STREAMER CHAMBER TRIGGERED BY PROPORTIONAL COUNTERS DESIGNED TO REGISTER STOPPING MESONS [STRIMERNAYA KAMERA, UPRAVLYAEMAYA PROPORTIONAL'NYMI SCHETCHIKAMI, DLYA REGISTRATSII OSTANOVOK MEDLENNYKH MEZONOV]

M. M. Kulyukin, D. B. Pontekorvo, I. V. Falomkin, D. M. Khazins, and Yu. A. Shcherbakov 1966 12 p refs In RUSSIAN

(JINR-P13-2998) CFSTI: HC$3.00/MF$0.65

A streamer chamber 140 mm high and 400 mm in diameter filled with helium with a 1% admixture of methane was made in order to register slow mesons stopping in the gas volume of the chamber. A multiwire proportional counter was constructed for selecting stopping slow mesons. It is shown that it is possible to operate both the counter and the chamber together in intensive meson beams. The chamber is triggered by two such multiwire proportional counters. The counters and the chamber have a common gas volume. A scintillation counter with a thin scintillator (1 mm) is used for preliminary selection of slow mesons. The properties of the chamber when it is operated in a charged particle beam with a repetition rate of 1 sec^{-1} and a time delay of some microseconds are discussed. Photographs of μ_e-decays are presented. The structure of tracks and its dependence upon the specific ionization of the registered particles is discussed. Author (NSA)

N67-23769# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.

THE EQUIPMENT FOR THE MEASUREMENT OF THE ANGULAR DISTRIBUTION OF N-17 PRODUCED IN THE HEAVY ION TRANSFER REACTIONS [APPARATURA DLYA IZMERENII UGLOVYKH RASPREDELENII YADER ^{17}N, VOZNIKAYUSHCHIKH V REAKTSIYAKH PEREDACHI S TYAZHELYMI IONAMI]

V. V. Volkov, L. Pomorski, and Ya. Tys 1966 17 p refs In RUSSIAN

(JINR-P13-2965) CFSTI: HC$3.00/MF$0.65

Equipment which is used in the investigation of the heavy ion transfer reaction by detection of delayed neutron activity of ^{17}N is described. The equipment consists of a reaction chamber, a neutron detector, and electronic and electromechanical parts. The equipment permits measurement of the differential cross sections of the reactions and the energetic distributions of the reaction products. Author (NSA)

N67-23770# Brookhaven National Lab., Upton, N. Y.

THEORY OF GRADIENT PERTURBATIONS IN THE AGS

J. C. Herrera and M. Month 8 Dec. 1966 17 p refs

(Contract AT(30-2)-GEN-16)

(BNL-10899) CFSTI: HC$3.00/MF$0.65

Gradient perturbation in the AGS was investigated, basing the development on the equations of motion in matrix form. Explicit expressions for the matrix of the perturbed system to all orders in the perturbing gradient function were derived. Using these expressions the betatron oscillation parameters were obtained to second order in the perturbation. As an illustration, the case of a distribution of point quadrupoles is considered. NSA

N67-23777# Ludwig-Maximilians-Universitat, Munich (West Germany).

REPORT ON ELECTRONS REFLECTED TO THE ANODES OF ANOMALOUS LONGITUDINALLY HINDERED H_2 GLOW DISCHARGES FOR INVESTIGATION IN YIELD CHAMBERS [DER BEITRAG DER AN DER ANODE VON ANOMALEN, LAENGSBEHINDERTEN H_2-GLIMMENTLADFALLRAUM]

Herbert Wellenhofer Jun. 1966 44 p refs In GERMAN

(NP-16434) CFSTI: HC$3.00/MF$0.65

From the electron energy distributions measured on the anode of strongly longitudinally delayed anomalous H_2 flow discharges, the multiplication M of the electron current density in the drop space was calculated. With these M values the stationarity condition was fulfilled. For the same discharge data, discharge voltage U, and dark space length PD, the energy distribution of the electrons at the glow border was calculated with consideration of the energy dependence of the ionization cross section of electrons in H_2 and of the energy loss of electrons in the ionization. The calculated distributions show the same characteristic pattern of the formation of beam electrons as the measured distributions. The variation between measured and calculated distribution functions is attributed to the effect of electrons which were reflected on the anode. These electrons have a supplementary ionization in the drop space as a result. This supplementary ionization is proportional to the reflection coefficient of the anode material. For the Al anode the increase of the drop space ionization is 30% and for the Ni anode it is 60%. The method used for the measurement of the energy distribution of electrons at the anode yields data on the mechanism in the drop space of a strongly longitudinally delayed glow discharge. Author (NSA)

N67-23786# Naval Ordnance Lab., Corona, Calif.

SOLID STATE SPECTROSCOPY INTERMEDIATE-COUPLING ENERGY LEVELS OF Sm^{3+} IN LaF_3

H. E. Rast, J. L. Fry, and H. H. Caspers *In its* Foundational Res. Proj. 1 Dec. 1966 p 55-86 refs (See N67-23781 12-23)

The intermediate coupling, free ion energy levels of the ^6FH multiplets have been calculated from energy matrices, including the effects of all the quartet and doublet states of the f^5 configuration. The experimentally determined barycenters of the crystalline Stark components have been fitted to a free-ion calculation of the energy levels in terms of the Slater integrals F_2, F_4, F_6, and the spin orbit parameter ζ_{4f}. A root mean square deviation of 12 cm^{-1} was achieved between the calculated and observed energies. The wave functions are tabulated for Sm^{3+} in LaF_3. Values of F_2=356.3 cm^{-1}, F_4=55.77 cm^{-1}, F_6=4.829 cm^{-1}, and ζ=1151 cm^{-1} are found to give the best overall agreement between the observed and calculated energy levels. Author

N67-23794*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

GAS DENSITY MEASUREMENTS USING LIGHT SCATTERING

Stuart L. Seaton Washington, NASA, Apr. 1967 27 p refs

(NASA-TN-D-3895) CFSTI: HC$3.00/MF$0.65 CSCL 20F

Experiments are described and results discussed for measuring gas density by means of laser light scattered by gases. Rayleigh theory is confirmed for the experimental conditions encountered. Polarizabilities experimentally obtained agree satisfactorily with those from other sources based on refractive indices of the test gases. It is concluded that the feasibility of the method has been established. Author

N67-23879# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

COLLISIONS OF SLOW ELECTRONS WITH ATOMS

V. Veldre 30 Jun. 1966 15 p refs Transl. into ENGLISH of the Monograph "Stolknoveniga Medlenny KH Elektronov s Atomami" Moscow, Inst. Fiz. Latv. SSR, 1965 p 1-9

(FTD-MT-65-542; TT-67-60311; AD-644072) CFSTI: HC $3.00/MF$0.65

The paper reviews the results of the investigations on collisions between electrons and atoms which have been recently carried out in the Institute of Physics of the Academy of Sciences of the Latvian SSR. The excitation of hydrogen atoms including exchange and strong coupling between three levels, the excitation of highly excited hydrogen atoms and the ionization of a hydrogen atom

are calculated. The results of calculations for the elastic scattering and excitation of atoms in alkali metals (lithium, sodium, potassium, and cesium) by electrons having the energy up to 5 ev are presented. The cross sections of a series of transitions in atoms of rare gases (neon, argon) treated by electrons were found. Author (TAB)

N67-23884# Lyon Univ. (France).
ELABORATION OF THE PROGRAM OF DISTORTED WAVE CALCULATION; APPLICATION TO VARIOUS STRIPPING REACTIONS [ELABORATION D'UN PROGRAMME DE CALCUL D'ONDES DISTORDUES APPLICATION A CERTAINES REACTIONS DE STRIPPING]
Georges Lamot (Ph.D. Thesis) 12 May 1966 86 p refs In FRENCH
(LYCEN-6634) CFSTI: HC$3.00/MF$0.65

The distorted-wave calculation plays a basic role in elastic scattering processes. This process is represented by means of interactions expressed with complex potentials. The hypotheses leading to the introduction of this type of potential in the study of nuclear reactions are reviewed. The cross section and the polarization of a particle scattered elastically by a nucleus are calculated. The stripping cross section is then calculated, using a classical analytical method and a graphic method. The results are applied to the numerical calculation of X(d,p)Y reactions. NSA

N67-23887# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ON DEUTERON STRIPPING REACTIONS ON DEFORMED NUCLEI [O REAKTSIYAKH DEITRONNOGO SRYVA NA DEFORMICROVANNYKH YADRAKH]
V. K. Luk'yanov and I. Zh. Petkov 1966 9 p refs In RUSSIAN
(JINR-P4-3070) CFSTI: HC$3.00/MF$0.65

Deuteron stripping reactions on deformed nuclei are considered in the adiabatic approximation in the framework of a distorted wave method. The selection rules are obtained. The method of treating experimental data which is applied in the analysis is not a precise one. Author (NSA)

N67-23888# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
CHARGE EXCHANGE OF NEGATIVE PION ON BOUND HYDROGEN NUCLEI [REAKTSIYA PEREZARYADKI π^--MEZONA NA YADRAKH SVYAZANNOGO VODORODA]
L. I. Ponomarev 1966 10 p refs In RUSSIAN
(JINR-P4-3072) CFSTI: HC$3.00/MF$0.65

A model of large mesic molecules, which was suggested earlier is developed. New experiments and the consequences of the model, which may be useful while analyzing these experiments, are discussed. Author (NSA)

N67-23889# Forsvarets Forskningsanstalt, Stockholm (Sweden).
REVIEW OF THE PUBLISHED VALUES OF THE NUMBER OF NEUTRONS EMITTED IN THE FISSION PROCESS
I. Asplund-Nilsson Mar. 1963 48 p refs
(NR-16440) CFSTI: HC$3.00/MF$0.65

A collection of $\bar{\nu}$-values is given for spontaneous and neutron-induced fission of different fissile isotopes. It contains values published up to July 1, 1962. Author (NSA)

N67-24028# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy).
PHOTOPRODUCTION OF NEUTRAL PIONS FOR INCIDENT PHOTON ENERGIES 400÷800 MeV. SEARCH FOR A RESONANT P_{11} STATE AND REMARKS ON THE η CUSP EFFECT
C. Bacci, G. Penso, G. Salvini (Rome Univ.), C. Mecuccini, A. Reale et al 5 Dec. 1966 34 p refs *Its* Nota Interna No. 340
(LNF-66/65) CFSTI: HC$3.00/MF$0.65

Photoproduction of neutral pions in the energy range $k \simeq 400$ to 800 MeV of the incident photon has been measured at the 1.1 GeV electron synchrotron. The differential cross section as a function of energy at the π^0 c.m. angles $\theta_{\pi^0} = 90°$, 120° and 135° has been determined. The main feature of the experiment is a good resolution in the energy of the incident photon. The results are compared with the existing theories in the energy range 450 to 550 MeV; the agreement is particularly good. All the cross sections exhibit a smooth behavior as a function of energy for 400 MeV $< k <$ 600 MeV. No immediate evidence is found of a contribution of the P_{11} resonance. An anomaly seems to appear for $k \simeq 700 \div 740$ MeV, indicating a structure in the region of the so-called second resonance. The general behavior of the cross section is examined taking into account the pion–nucleon scattering results. In particular, an attempt was made to interpret the observed anomaly as a reflection of the sharp opening of the η production channel (η cusp effect). Author

N67-24029# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy).
POSITIVE PION PHOTOPRODUCTION WITH COHERENT BREMSSTRAHLUNG. I: EXPERIMENTAL METHOD AND RESULTS
R. Giantin, M. Grilli, M. Nigro, E. Schiavuta, P. Spillantini et al 20 Dec. 1966 22 p refs *Its* Nota Interna No. 343
(LNF-66/68) CFSTI: HC$3.00/MF$0.65

The apparatus and the experimental method used for the measurements of the single π^+ photoproduction by linearly polarized γ rays is described. The present results on the asymmetry ratio $A(\theta)$ are summarized. The range covered by our results is $\theta = 30° \div 145°$ (C.M.) and $E_\gamma = 200 - 450$ MeV. Author

N67-24030# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy).
A POLE MODEL FOR $\eta \to 3\pi$ DECAYS
V. Silvestrini, L. Maiani, and G. Preparata 11 Jun. 1967 12 p refs Submitted for publication *Its* Nota Interna No. 344
(LNF-67/2) CFSTI: HC$3.00/MF$0.65

A simple pole model, which takes into account the contributions of the σ and ζ particles, is found to give an overall consistent picture of the $\eta \to 3\pi$ decays. The branching ratio $R = \eta \to 3\pi^0/\eta \to \pi^+\pi^-\pi^0$ is predicted to be $R_{th} = 1.0$ to be compared with $R_{exp} = 1.05 \pm .13$. A good fit to the population of the Dalitz plot for the decay $\eta \to \pi^+\pi^-\pi^0$ is obtained, together with the reasonable estimate $\Gamma_{\eta \to \pi^+\pi^-\pi^0}$. Author

N67-24046*# Douglas Aircraft Co., Inc., Huntington Beach, Calif. Advanced Research Lab.
THE IONIZATION OF HYDROGEN AND OF HYDROGENIC POSITIVE IONS BY ELECTRON IMPACT
M. R. H. Rudge and S. B. Schwartz (High Altitude Obs.) Feb. 1966 52 p refs *Its* Res. Commun. No. 10
(NASA-CR-83845 Douglas Paper-4007; G-5040; AD-644978) CFSTI: HC $3.00/MF $0.65 CSCL 20H

Calculations of the ionization cross sections of hydrogen and of hydrogenic positive ions are described in which the initial state is either the ground or the excited 2s state. The first procedures used are the Born (ii) and Born-exchange approximations. These results are compared with other theoretical calculations and with experimental data. It is seen that for the case of ionization of hydrogen from its ground state, none of the theoretical results is in good agreement with the experimental data. A certain defect of the theory is then corrected by adopting a third procedure for this case, in which an angle-dependent Coulomb potential is used in the description of the final state of the e-H ionization problem.

It is then found that, despite the sounder theoretical footing of this latter calculation, no improved agreement with experimental data is obtained except in the near threshold region. Convenient formulae are presented which represent the best data for the ionization cross sections and the associated reaction rates for the case of an initial Maxwellian distribution of velocities. Author (TAB)

N67-24094# National Inst. for Research in Nuclear Science, Harwell (England). Rutherford High Energy Lab.
DESIGN EQUATIONS OF AN ALVAREZ-TYPE PROTON LINEAR ACCELERATOR
A. Carne and P. M. Lapostolle (CERN) *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 201–206 refs Prepared Jointly with CERN (See N67-24061 12-11)

The accurate beam dynamics equations for an Alvarez-type linac can be used to give cell-by-cell design data. In particular, the cell lengths can be chosen such that a reference particle follows any phase law, in a tank where the mean E-field can be chosen arbitrarily, and where drift tube diameters and apertures may also vary. The S term for a particle in a gap is derived, and correction to both S and T in the design for a nonzero inner profile radius of curvature is discussed. Finally, the axial equations of motion in such a linac are stated. Author (NSA)

N67-24095# Massachusetts Univ., Amherst. Dept. of Physics.
TRANSVERSE BEAM GROWTH DUE TO LONGITUDINAL COUPLING IN LINEAR ACCELERATORS
Robert L. Gluckstern *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 208–213 refs Sponsored by AEC and NSF (See N67-24061 12-11)

The usual approximation for treating orbit dynamics in linear and circular accelerators is to consider the longitudinal and two transverse motions to be uncoupled and to treat the development of the corresponding 2×2 phase spaces independently. An effort to include the effect of these coupling terms to the two lowest orders was made in order to determine their influence on transverse beam size. Comparison of these results with orbit computations indicated agreement for the lowest order term, but not for the term which would be resonant if the longitudinal and transverse oscillation frequencies were equal. The present report reviews the analysis, yielding a result for the second order term which takes into account higher order terms in the first coupling term. This result now appears to be in general agreement with the orbit computations and can be used as the basis for predicting transverse beam growths due to this coupling. Author (NSA)

N67-24096# Yale Univ., New Haven, Conn. Dept. of Physics.
COUPLED MOTION IN LOW-ENERGY PROTON LINEAR ACCELERATORS
S. Ohnuma *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 214–219 refs Sponsored by AEC (See N67-24061 12-11)

The coupling effect in proton linear accelerators was studied from a viewpoint which is based on the theory of the strong focusing system by Courant and Snyder. NSA

N67-24097# Yale Univ., New Haven, Conn. Dept. of Physics.
ON A UNIFORM CHARGE DENSITY OF A BEAM AND ITS PHASE-SPACE DISTRIBUTION
S. Ohnuma *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 220–223 refs Sponsored by AEC (See N67-24061 12-11)

It is shown that, if a particle beam with a constant velocity and a constant current going through a linear focusing field has a uniform charge density everywhere, its particle distribution in the four-dimensional (transverse) phase space must be of the type assumed by Kapchinskij and Vladimirskij. All the particles are then distributed uniformly on the surface of a four-dimensional ellipsoid. Since the Fourier transform of the Kapchinskij–Vladimirskij distribution has the same form for accelerated and unaccelerated beams, it is expected that this is true for accelerated beams also provided one can ignore the effect of the transverse motion on the longitudinal motion. The method used is based on the Fourier transform of the particle distribution. Author (NSA)

N67-24098# Brookhaven National Lab., Upton, N. Y.
NUMERICAL CALCULATIONS OF COUPLING EFFECTS IN A LOW ENERGY PROTON LINAC
R. Chasman *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 224–228 refs Sponsored by AEC (See N67-24061 12-11)

The following is a brief description of numerical calculations on the coupling effects mentioned, namely coupling between the longitudinal and transverse motions and coupling between the two transverse motions due to the quadrupole fringing fields. In the former case, only the influence on the transverse motion was considered. All computations were done on the CDC 6600 computer at Brookhaven National Laboratory. The basic particle dynamics program assumes that the acceleration takes place in an infinitesimally small interval. The transit time factor in each cell is a function of the energy of each individual particle and a change in phase is introduced at the accelerator gap to guarantee conservation of longitudinal phase space area (Promé approximation). Author

N67-24099# Los Alamos Scientific Lab., N. Mex.
COMPARISON OF THE PARTICLE MOTIONS AS CALCULATED BY TWO DIFFERENT DYNAMICS PROGRAMS
D. A. Swenson, D. E. Young, and B. Austin (Midwestern Univ. Res. Assoc., Stoughton, Wis.) *In its* Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 229–232 Prepared jointly with Midwestern Univ., Res. Assoc., Stoughton, Wis. (See N67-24061 12-11)

A comparison is presented of the PARMILA and LINDY computer codes which are designed to integrate the equations of motion of electrons or ions in the electromagnetic fields of the basic linac geometry. NSA

N67-24100# Los Alamos Scientific Lab., N. Mex.
A NUMERICAL EXPERIMENT ON SPACE-CHARGE EFFECTS
K. R. Crandall *In its* Proc. of the 1966 Linear Accelerator Conf. Dec. p 223–236 refs (See N67-24061 12-11)

A numerical experiment was devised to study the effects of space charge on the charge density, apparent emittance, and the beam profile of an axially symmetric, non-accelerating beam. All of the particles in the beam are assumed to have the same axial velocity z, and the beam radius and the charge density are assumed to change slowly enough with respect to z so that the electric field due to space charge is entirely in the radial direction. NSA

N67-24101# Massachusetts Univ., Amherst. Dept. of Physics.
SPACE CHARGE EFFECTS IN PROTON LINEAR ACCELERATORS
Robert L. Gluckstern *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 237–242 refs Sponsored by AEC and NSF (See N67-24061 12-11)

In recent years, the development of ion sources has led to a substantial increase in the currents accelerated in proton linacs. Accelerated currents in excess of 100 mA have been obtained at CERN, and similar currents are expected for the 200 MeV linac which is to be part of the AGS improvement program. The purpose of this note is to investigate the effects of high space

charge on both the longitudinal and transverse motions in order to see whether these effects will be serious for the particular parameters of the planned linac. We shall try to obtain rough analytical guides for the corresponding computational program under way at BNL. Author (NSA)

N67-24102# Brookhaven National Lab., Upton, N. Y.
SPACE CHARGE EFFECTS ON LONGITUDINAL MOTION IN PROTON LINACS
A. Benton and C. Agritellis *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 243–244 refs Sponsored by AEC (See N67-24061 12-11)

Several subroutines written for an existing BNL longitudinal motion program (LONMO) to include space charge effects. The basic program without space charge assumes all energy supplied to the particles by the rf field to be imparted at gap centers. The particles drift between centers at constant velocity and the phase changes are calculated without the Promé correction. Space charge effects are calculated by Lapostolle's formulas. The program calculates the center of gravity and second moment of the packet of charges and replaces it with a uniformly charged ellipsoid having the same center of gravity and second moment. The longitudinal axis of the ellipsoid is determined by the second moment; the axes in the transverse plane are specified as input to the program. Lapostolle supplies formulas for the energy change produced by space charge forces assuming the beam to be travelling in an infinitely long conducting cylinder while in a drift tube, and between two infinite parallel conducting plates while in a gap. These energies are added at the centers of the drift tubes and gaps respectively. In spaces between cavities, space charge contributions to energy are calculated by the same formulas as in drift tubes (merely changing the radius of the surrounding cylinder) and are added at intervals of $\beta\lambda$. NSA

N67-24103# Rennes Univ. (France). Faculte des Sciences.
PHASE-SPACE REPRESENTATION OF ABERRATIONS DUE TO LONGITUDINAL FIELDS IN QUADRUPOLES
E. Regenstreif and P. Tanguy *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 245–249 (See N67-24061 12-11)

In a certain number of practical arrangements, the length of a quadrupole used for focusing purposes may be comparable to its aperture. This can happen for instance at the exit of a short pre-accelerating column or in the first focusing stages of a linear accelerator. The situation at the exit of a focusing system where the presence of a longitudinal field and the coupling due to aberrations may influence the beam behaviors represented in phase space. Author (NSA)

N67-24104# Massachusetts Univ., Amherst. Dept. of Physics.
THE EFFECT OF QUADRUPOLE FRINGING FIELDS ON COUPLING IN LINACS
Robert L. Gluckstern *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 250–253 refs Sponsored by AEC and NSF (See N67-24061 12-11)

The effect of quadrupole fringing fields on transverse emittance has recently been pointed out by Regenstreif. He finds serious aberrations which must be taken into account in the design of transport systems. The purpose of this note is to examine the effects of quadrupole fringing fields in linacs on the transverse motion. Author

N67-24105# Stanford Univ., Calif. Linear Accelerator Center.
COMPUTER STUDY OF WAVE PROPAGATION, BEAM LOADING AND BEAM BLOWUP IN THE SLAC ACCELERATOR
R. Helm *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 254–266 refs Sponsored by AEC (See N67-24061 12-11)

The classical type of beam blowup or pulse shortening which is observed in many short, high-current electron linacs has been convincingly identified as a regenerative interaction between the beam and the HEM_{11} deflecting mode, which is the next pass band above the accelerating mode. The beam blowup observed at SLAC, occurs at a frequency within the HEM_{11} pass band but at currents at least an order of magnitude lower than the threshold for the regenerative oscillation. Evidently then this is a case of the cascaded amplifier mechanism. As an intermediate goal in the development of a computer program, the case of wave propagation and beam loading in the accelerating mode was treated. NSA

N67-24106# Stanford Univ., Calif. Linear Accelerator Center.
BEAM BREAK-UP EXPERIMENTS AT SLAC
O. H. Altenmueller, E. V. Farinholt, Z. D. Farkas, W. B. Herrmannsfeldt, H. A. Hogg et al *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 267–280 refs Sponsored by AEC (See N67-24061 12-11)

The first observation of beam break-up at SLAC was made on April 27, 1966, one week after the beam was first turned on over two-thirds of the accelerator's two-mile length. The event caused more astonishment than panic because the observed beam break-up current threshold of 10 to 20 mA peak, while much lower than in other shorter accelerators, was not far from the 50 mA peak current specified for the two-mile accelerator. Considerable analytical and experimental work has been done at SLAC to understand the beam break-up effect and to formulate a practical corrective program. The present paper attempts to describe most of the experiments carried out, both on cold tests and on the accelerator itself. In summary, this paper will start out by describing the beam break-up effect, both qualitatively and quantitatively, as it has been observed and understood so far. This description will be followed by the presentation of results derived from microwave cold tests, microwave beam tests, focusing beam tests, and a few other miscellaneous experiments involving the beam. From all these experiments, it will be seen how the presently adopted corrective program was arrived at. Author

N67-24107# Massachusetts Univ., Amherst.
A NOTE ON TRANSVERSE BEAM INSTABILITIES IN MULTISECTION LINACS
R. L. Gluckstern, D. E. Nagle, and W. M. Visscher (Los Alamos Sci. Lab.) *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 281–283 refs Sponsored by AEC and NSF (See N67-24061 12-11)

Preliminary operation of the Stanford Two-Mile Electron Accelerator has uncovered an unexpected transverse beam instability at a beam current below the design value. Various tests of the dependence of this effect on the pulse length, section length, beam current, and transverse focusing forces indicate that it is a cooperative phenomenon between transverse field oscillations in the various sections. A model was constructed for this beam blowup in the absence of large focusing forces, similar to those of Panofsky and of Sessler. The e-folding factor was estimated in terms of the starting current for runaway transverse oscillations in the first section. Author (NSA)

N67-24108# Los Alamos Scientific Lab., N. Mex.
SIMPLE MODELS FOR BEAM-BLOWUP
William M. Visscher *In its* Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 284–293 refs (See N67-24061 12-11)

A chain of independent cylindrical cavities is a simple model for a linac and is the one which is considered. The normal-mode fields are described in detail, as is their interaction with an off-axis beam, and the resulting equation for beam deflection is displayed.

The magnitude of the coefficient in this equation has a simple physical interpretation; namely, it is the electrostatic force attracting the bunch to its image induced in the wall of the accelerating tube. A discussion of deflection caused by cooperative buildup of the tranaverse fields by the beam bunches in a more general linac model is presented. An equivalent circuit description of a chain of cavities with linear coupling to nearest neighbors is worked out. The relations between the eigenvectors and eigenvalues of this system and the parameters of the bunched off-axis beam which are relevant to beam-blowup are discussed, as is the section-to-section variation in the normal modes which is consistent with coherent transverse-field buildup. NSA

N67-24118# Midwestern Universities Research Association, Stoughton, Wis.
EXPECTATIONS AND POSSIBLE INTERPRETATION OF ION SOURCE BEHAVIOR
C. D. Curtis *In* LASL Proc. of the 1966 Linear Accelerator Conf. Dec. 1966 p 390–393 refs Sponsored by AEC (See N67-24061 12-11)

The question as to whether an ultimate emittance or phase space density for some given beam current is being approached is discussed in relation to recent progress in ion source performance. A related question is also discussed having to do with what change in emittance should be expected from a well-behaved ion source when its beam current is increased. NSA

N67-24157# Oak Ridge National Lab., Tenn.
THE EFFECT OF CHARGED-PARTICLE SLOWING DOWN ON THE NUCLEAR CASCADE IN STEEL INITIATED BY 19.2-GeV/c PROTONS
R. G. Alsmiller, Jr., F. S. Alsmiller, and J. B. Barish Jan. 1967 15 p refs
(Contract W-7405-ENG-26)
(ORNL-3854) CFSTI: HC $3.00/MF $0.65

A numerical solution to the one-dimensional nucleon–meson cascade equations is obtained for the case of the nuclear cascade in steel initiated by 19.2-GeV/c protons under the assumption that proton and charged pion slowing-down may be neglected. This solution is compared to the solution obtained when slowing-down is included and large differences in the low energy ($\approx$100-MeV) particle intensities are found. Author (NSA)

N67-24198# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
DEPENDENCE OF INDUCED COLORATION IN GLASS ON PENETRATION DEPTH OF FAST ELECTRONS
Joseph Y. Chang Dec. 1966 16 p refs
(RM-350) CFSTI: HC $3.00/MF $0.65

Multiple thin disks of glass were irradiated with 1 MeV electrons to study the effect of electron energy attenuation on induced coloration. In addition to the known positive absorption bands in the near UV and visible regions, an induced band of negative absorption (clearing) was observed at a band maximum of 2050 Å. This negative absorption band is interpreted as resulting from the reduction of ferric ions (Fe^{3+}), originally present in the glass, by electron capturing. Further examination of the experimental data revealed that while the positive absorption band in the near UV (trapped holes) is related to energy deposition in the individual disks, the negative band does not exhibit the same correlation. Detailed analysis of data indicates that the electron capture of Fe^{3+} has an energy dependent cross section $\sigma = C(\bar{E})^{-n}$ where C is constant, $\bar{E}$ the average electron energy within a given disk, and $n = 1.7 \pm 0.3$ within experimental error. Author

N67-24286 Tokyo Univ. (Japan). Dept. of Physics.
MESONS AS REGGE DIPOLE
Tetsuo Sawada [1966] 11 p refs
CFSTI: HC $3.00

Under the assumption that the high energy behavior of the scattering amplitude A(s,z) and the second sheet amplitude $A_{(s,z)}$ are described by the finite number of Regge poles of the crossed channels, it is shown, by using the unitarity condition, that all the Regge trajectories with $R_e\alpha(0) > 1/4$ must be a Regge dipole rather than a Regge (mono)-pole. The restrictions on the Regge parameters are derived and the possibility to predict a new trajectory is also pointed out. Implication of the dipole structure of the Regge trajectories is discussed, in particular concerning the nucleon form factor. Author

N67-24281 Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
TESTS OF AXIAL CURRENT ALGEBRA IN PION–NUCLEON PHYSICS
C. Bouchiat, G. Flamand, and Ph. Meyer Feb. 1967 13 p refs
(TH-187) CFSTI: $3.00

Tests of axial current algebra in the form of low energy theorems are discussed. The extrapolation on the energy is carried out exactly on the mass shell using dispersion relations. Performing the mass extrapolation in a definite way gives perfect agreement with experiment for the algebra of charges. A discrepancy is found for the algebra of current densities if one uses the somewhat uncertain determinations of the p-wave scattering lengths. The need for precise low energy pion nucleon scattering experiments is emphasized. Author

N67-24419# American Meterological Society, Boston, Mass.
THE HYPERFINE STRUCTURE OF SPECTRAL LINES AND NUCLEAR MAGNETISM OF MANY-ELECTRON ATOMIC SPECIES [SVERKHTONKAIA STRUKTURA SPEKTRAL'NYKH LINII I IADERNYI MAGNETIZM DLIA MONOGOELEKTRONNYKH ATOMOV]
V. V. Klingo Nov. 1966 18 p refs Transl. into ENGLISH from Russian
(Contract AF 19(628)-3880)
(T-R-620; AD-647558)

Values of the hyperfine structure constants are calculated theoretically for many-electron atoms within the limits of nonrelativistic quantum mechanics and are compared with experimental data. By comparison of the ratios of the experimental values for the magnetic hyperfine structure constants with a certain ratio of the magnetic moments and spins for isotopes of the same term, it is shown that the discrepancy between theory and experiment cannot be completely eliminated by refinement of the orbitals alone. One must allow for an additional contribution from the magnetic interaction between the electrons and the spatially finite atomic nucleus. Author (TAB)

N67-24547*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
RADIATION PHYSICS RESEARCH AT MSFC
Russell D. Shelton 1966 35 p refs *Its* Res. Achievements Rev., Vol. II, Rept.-1
(NASA-TM-X-53556) CFSTI: HC $3.00/MF $0.65 CSCL 18F

The status and scope of the Radiation Research Program at Marshall Space Flight Center are described. The application of radiation to engineering problems and the effects of nuclear and space radiation on materials and components are discussed. The Propulsion and Vehicle Engineering Laboratory has continued its testing of materials under reactor space radiation environments. The Astrionics Laboratory is concerned with the effects of radiation on electronic components and the development and calibration of instrumentation for the measurement of the radiation environment. The Research Projects Laboratory has been primarily concerned with the transport of radiation through shields and the aspects of radiation from the physical viewpoint. Several applications of

radiation for the solution of engineering problems are discussed briefly to indicate their feasibility and to provide contract and document references. Author

N67-24549# Los Alamos Scientific Lab., N. Mex.
BIORTHOGONAL ANGULAR POLYNOMIAL EXPANSIONS OF THE BOLTZMANN TRANSPORT EQUATION
K. D. Lathrop and Nelson S. De Muth 16 Jan. 1967 64 p refs
(Contract W-7405-ENG-36)
(LA-3617) CFSTI: HC $3.00/MF $0.65

A system of biorthogonal polynomials is developed for the angular expansion of the directional flux in the linear Boltzmann transport equation. Recursion relations and an addition theorem are derived for a system of biorthogonal polynomials shown by Didon to be orthogonal over the unit hemisphere. These polynomials are applied to two-dimensional forms of the Boltzmann equation. Equations for the coefficients of expansion are derived when the directional flux is expanded in a series of either system of polynomials. One of these systems of equations is shown to be a linear combination (with specific coefficients) of the equations obtained when the directional flux is expanded in spherical harmonic functions, and it is shown that this same system reduces to the spherical harmonics equations in one-dimensional plane geometry. Author (NSA)

N67-24559# Idaho Nuclear Corp., Idaho Falls. National Reactor Testing Station.
TABULATION OF THE TOTAL NEUTRON CROSS SECTION OF ^{232}U
O. D. Simpson, M. S. Moore, and J. R. Berreth Dec. 1966 69 p refs
(Contract AT(10-1)-1230)
(IN-1015) CFSTI: HC $3.00/MF $0.65

The total neutron cross section of ^{232}U has been measured from 0.01 to 10,000 eV using the Materials Testing Reactor (MTR) fast chopper. A 2200 meter/sec total neutron cross section of 165±10 barns was determined. Multilevel parameters are listed for resonances below 30 eV. Results of the analysis indicate that two fission channels are needed to describe the experimental data. A tabulation of the data is given in the attached appendix. Author

N67-24560# Idaho Nuclear Corp., Idaho Falls. National Reactor Testing Station.
TABULATION OF THE ^{228}Th TOTAL NEUTRON CROSS SECTIONS FOR THE 1.9 AND 7.5 eV RESONANCES
O. D. Simpson, R. P. Schuman, and J. R. Berreth Dec. 1966 16 p refs
(Contract AT(10-1)-1230)
(IN-1040) CFSTI: HC $3.00/MF $0.65

The total neutron cross section of ^{228}Th was measured in the regions of 1.9 and 7.5 eV, using the Materials Testing Reactor fast chopper. Breit–Wigner single level resonance parameters are given for the two resonances observed. Author (NSA)

N67-24568# California Univ., Livermore. Lawrence Radiation Lab.
FAST NEUTRON CROSS SECTIONS INFERRED FROM CHARGED-PARTICLE DATA AND FROM THE APPLICATION OF NUCLEAR MODELS
John D. Anderson and Harry F. Lutz 13 Jun. 1966 44 p refs
(UCRL-14955) CFSTI: HC $3.00/MF $0.65

The possibility of using charged particle data together with various nuclear models to generate neutron data is studied. A general description of the interaction of nucleons with matter in terms of specific models (optical model, extended optical model, charge independence, and charge symmetry) is presented, along with sufficient data to indicate the general usefulness of the models in generating nuclear cross sections. Author (NSA)

N67-24573# Idaho Nuclear Corp., Idaho Falls.
VARIATION WITH NEUTRON ENERGY OF THE YIELD OF HIGH KINETIC ENERGY FRAGMENTS FROM ^{233}U, ^{235}U AND ^{239}Pu
L. G. Miller and M. S. Moore Nov. 1966 31 p refs
(Contract AT(10-1)-1230)
(IN-1033) CFSTI: HC $3.00/MF $0.65

A fission chamber was devised which detects with high efficiency those fission events in which the kinetic energy release of the heavier binary fragment is maximal. This detector was used, in conjunction with a conventional fission detector (whose efficiency is independent of fragment energy), in a study of the relative yield of high kinetic energy fission of ^{233}U, ^{235}U, and ^{239}Pu, induced by low-energy neutrons. The variations in the yield of high kinetic energy fragments indicate a qualitative correlation with results of measurements of the relative symmetric fission yield as a function of neutron energy. This correlation, however, suggests that the increased relative symmetric fission is accompanied by an increased relative yield of high kinetic energy fragments, contrary to what was previously assumed on the basis of current models of the fission process. Author (NSA)

N67-24578# Oak Ridge National Lab., Tenn.
RELATIVISTIC AND NON-RELATIVISTIC SCF WAVE FUNCTIONS FOR ATOMS AND IONS FROM Z=2 TO 80, TOGETHER WITH CALCULATIONS OF BINDING ENERGIES, MEAN RADII, SCREENING CONSTANTS, CHARGE DISTRIBUTIONS, AND ELECTRON SHAKE-OFF PROBABILITIES
C. W. Nestor, T. C. Tucker, T. A. Carlson, L. D. Roberts, F. B. Malik (Yale Univ.) et al Dec. 1966 92 p ref
(Contract W-7405-ENG-26)
(ORNL-4027) CFSTI: HC $3.00/MF $0.65

Two groups of Fortran programs for the CDC 1604-A computer for calculating atomic wave functions, and some calculations performed with them are discussed. The first code gives a non-relativistic Hartree–Fock solution, while the other group of codes yields a relativistic Hartree solution, to which an exchange correction may be added. Over 60 sets of wave functions for atoms and ions have been calculated. A number of solutions are for ions with vacancies in their inner shells. Energy eigenvalues, mean radii and screening constants are tabulated for each set. Plots of the electron distribution, which are also available for each wave function, are described. These wave functions have been used to calculate the probability of electron shake-off as the result of the following processes: β^- decay, electron capture, photoionization, and Auger transitions; and results of these calculations are given for nearly 40 cases. A brief discussion is given of a non-relativistic continuum wave function program and of the use of the Wigner–Seitz boundary condition in the relativistic Hartree calculation. Author (NSA)

N67-24595# European Atomic Energy Community, Ispra (Italy).
SOME NUMERICAL SCHEMES FOR NEUTRON DIFFUSION PROBLEMS
J. P. Roos Brussels, EURATOM, Jan. 1967 51 p refs
(EUR-3262.e) CFSTI: HC $3.00/MF $0.65

In order to solve general elliptic equations we compare with respect to the convergence and accuracy three finite difference schemes, the five-point, the nine-point, and the mixed type formulas. The mixed type scheme seems very efficient in particular since it can easily deal with general interfaces. Author

N67-24623*# TRW Systems, Redondo Beach, Calif.
IONIZATION PROBABILITY OF IRON PARTICLES AT METEORIC VELOCITIES
J. C. Slattery and J. F. Friichtenicht Washington, NASA, May 1967 21 p refs
(Contract NASw-1336)
(NASA-CR-775) CFSTI: HC$3.00/MF$0.65 CSCL 03B

The number of ion pairs produced by the total ablation of iron particles in air and argon was measured as a function of particle velocity. Micron size iron particles of known mass and velocity were injected into a gas target chamber and the resultant ionization collected with a parallel plate ionization chamber. Initial velocities of the particles ranged from 20 km/sec to 45 km/sec. The ionization probability β, for an iron particle in argon was found to be $\beta = 2.75\times10^{-20}v^{4.13}$, where v is the particle velocity in meters/sec. The ionization probability of an iron particle in air was found to be $\beta = 2.60\times10^{-15}v^{3.12}$, with v in meters/sec. Author

N67-24640*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
FORBIDDEN PHOTOIONIZATION AND ELECTRON SPIN POLARIZATION
Lue-Yung Chow Chiu Jul. 1965 20 p refs Submitted for publication
(NASA-TM-X-55543; X-694-66-295) CFSTI: HC $3.00/MF $0.65 CSCL 20H

A new mechanism involving normally forbidden processes, namely spin dependent electric dipole and spin dependent magnetic quadrupole transitions, is applied to the photoionization of atoms with a single n s outer electron. If the incident light is circularly polarized, the photoionized electrons via these processes are shown to be spin polarized with the direction of light propagation as the axis of the spin quantization. The cross section of photoionization by these transitions is shown to be at its quantization axis and is computed for the case of H, Li, and Na. This is in contrast to the spin independent multipole transitions where the cross section is zero for electrons ejected in parallel to that direction. The photo-ejected electrons are shown to be 100% spin polarized when they propagate along the quantization axis. However the spin polarization drops rapidly when the electron propagation vector deviates from the axis. This is illustrated by the calculations on H, Li, and Na. Author

N67-24665# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
ELECTRON-GAMMA DIRECTIONAL CORRELATIONS
Tor Ragnar Gerholm Oct. 1966 50 p In FRENCH
(CEA-R-3025) CFSTI: HC$3.00/MF$0.65

The theory of the angular correlation between conversion electrons and gamma rays is briefly outlined. The experimental methods used for the study of the electron-gamma correlation are described. The effects of the formation of a hole and the hyperfine structure magnetic coupling dependent on time are then considered. The experimental results showed that the attenuations found for different metallic media plainly conform to a simple quadripolar interaction mechanism. For a source surrounded by an insulator, however, the results show that a rapidly disappearing coupling occurs as a supplement to the quadripolar interaction mechanism. This coupling attenuates the angular correlation by about 75% of the non-perturbed value. It was concluded that for an intermediate half life of the level of the order of the nanosecond, the attenuations produced by the secondary effects of the hole formation can not be completely neglected. The metallic media considered were Ag, Au, Al, and Ga. In the study of E2 conversion processes, the radical matrix elements governing the E2 conversion process in the 412-keV transition of ^{198}Hg were determined. The results exclude the presence of dynamic contributions within the limits of experimental error. NSA

N67-24668# California Univ., Davis.
NUCLEAR REACTIONS AT HIGH ENERGIES Final Report
John Warren 15 May 1966 31 p
(Contract AT(11-1)-34)
(UCD-34P75-1) CFSTI: HC$3.00/MF$0.65

The isobaric cross-section ratios $^{45}Ti/^{45}Ca$, $^{48}Cr/^{48}V$, $^{52}Fe/^{52}Mn$, $^{55}Co/^{55}Fe$, and $^{56}Ni/^{56}Co$ from alpha and proton reactions in Cu foils at 310 to 880 MeV and 230 to 760 MeV, respectively, were measured. Excitation functions were measured for the production of Co isotopes including ^{58m}Co and ^{58g}Co, in alpha and proton reactions in Co foils at 330 to 880 MeV and 100 to 720 MeV, respectively. Secondary reactions produced in Cu foils by alpha particles of 330 to 880 MeV and protons of 270 to 730 MeV were also investigated. Apparent cross sections for the production of ^{71}As, ^{72}As, and ^{69}Ge were determined. At proton energies of 270, 500, and 730 MeV and at an alpha energy of 330 MeV, the cross sections were studied as a function of target thickness. NSA

N67-24671# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ON THE COULOMB INTERACTION IN NUCLEI [O KULONOVSKOM VZAIMODEISTVII V YADRAKH]
G. M. Vagradov, F. A. Gareev, and B. N. Kalinkin 1966 13 p In RUSSIAN
(JINR-P4-2981) CFSTI: HC$3.00/MF$0.65

The correlative force effects on the Coulomb interaction of nucleons in nuclei are considered. It is shown in the approximation of the Fermi-liquid theory that taking these forces into account explains the difference in the depths of proton and neutron average fields. Author (NSA)

N67-24675# Technische Hochscule, Karlsruhe (West Germany). Institut fuer Struktur der Materie.
NEUTRON SPECTRA IN INFINITE, HOMOGENEOUS ARBITRARY MODERATORS [NEUTRONENSPEKTREN IN HOMOGENEN, UNENDLICH AUSGEDEHNTEN, BELIEBIGEN MODERATOREN]
H. Rietschel Jul. 1966 46 p In GERMAN
(BMwF-FBK-66-21) CFSTI: HC$3.00/MF$0.65

A mathematical method for calculating neutron spectra in homogeneous infinite media with absorption proportional to $E^{-0.5}$ is outlined. It is shown that the properties of the moderator concerning thermalization can be characterized by 5 parameters with excellent accuracy. This procedure represents an enlargement of a method given by Kunze, where the heavy gas operator is replaced by a Horowitz operator. Author (NSA)

N67-24676# General Dynamics Corp., San Diego, Calif. General Atomic Div.
GASKET: A UNIFIED CODE FOR THERMAL NEUTRON SCATTERING
J. U. Koppel, J. R. Triplett, and Y. D. Nailiboff 22 Sep. 1966 80 p
(Contract AT(04-3)-167)
(GA-7417) CFSTI: HC$3.00/MF$0.65

The computer code GASKET, which was developed as a unified method for calculating thermal neutron scattering kernels for all moderators, is described. NSA

N67-24677# Artiebolaget Atomenergi, Studsvik (Sweden).
PROGRESS REPORT TO E.A.N.D.C. FROM SWEDEN, MARCH 1966
N. Starfelt, ed. [1966] 16 p
(EANDC(OR)-44(L)) CFSTI: HC$3.00/MF$0.65

The research progress and programs at the Swedish facilities are summarized. Studies of neutron emission in the fast-neutron

fission of ^{241}Pu; neutron resonance radiative capture cross sections of 2ald shell nuclei; neutron angular distributions from (p,n) reactions on ^{9}Be and ^{7}Li; fast-neutron attenuation in natural U and masonite; cold-neutron scattering by n-propyl alcohol; the effects of fast neutrons on single crystals of Al; the energy levels of ^{155}Eu, ^{179}Hf, ^{161}Tb, and ^{177}Yb transitions in deformed nuclei; the levels of ^{163}Dy and ^{166}Ho; the decay of ^{149}Nd and ^{182}Ta to ^{149}Pm and ^{182}W, respectively; fast-neutron scattering by Co, Fe, and ^{57}Fe; the scattering of polarized fast neutrons by Cu, Pb, and Mo; and neutron angular distributions and spectra from (p,n) reactions on ^{42}Ca, ^{44}Ca, ^{50}Cr, ^{54}Fe, and ^{31}P are briefly covered. NSA

N67-24678# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics.

ANGULAR DISTRIBUTIONS OF NEUTRONS FROM THE C-12(T,N) N-14 REACTION [UGLOVYE RASPREDELENIYA NEITRONOV IZ REAKTSII $^{12}C(t,n)^{14}N$]

K. Malushinska, M. Pshitula, and I. V. Sizov 1966 11 p In RUSSIAN

(JINR-P3-3079) CFSTI: HC$3.00/MF$0.65

The energy spectra and angular distributions of three groups of neutrons from the $^{12}C(t,n)^{14}N$ reaction, which correspond to the main and two first excited states of a final ^{14}N nucleus were measured. The measurements were performed by the nuclear photoemulsion method at E_t=1.7 MeV. The angular distributions of the n_1 group neutrons (2.31-MeV state of ^{14}N) are compared to that of protons from the $^{12}C(t,p_0)^{14}C$ reaction for the ground state of ^{14}C. The proton–neutron angular distributions for the corresponding states of final nuclei are similar. Author (NSA)

N67-24679# Technische Hochschule, Karlsruhe (West Germany). Institut fuer Struktur der Materie.

EXACT SOLUTION OF MONOENERGETIC NEUTRON TRANSPORT EQUATION WITH LINEAR ANISOTROPIC SCATTERING FUNCTION IN PLANE GEOMETRY [EXAKTE LOESUNG DER MONOENERGETISCHEN NEUTRONEN-TRANSPORTGLEICHUNG MIT LINEARANISOTROPER STREUFUNKTION IN EBENER GEOMETRIE, DEMONSTRIERT AM BEISPIEL DES MILNE-PROBLEMS]

G. Haungs Jul. 1966 102 p In GERMAN

(BMwF-FBK-66-18) CFSTI: HC$3.00/MF$0.65

The starting point of this work is the spherical harmonics method with linear anisotropic scattering as elaborated by W. Kofink. For the classical example of the transport theory, the Milne Problem, the solution is given in an P_L approximation. With a generalized H-function of Chandrasekhar the limit $L\to\infty$ is performed, and the exact solution is obtained. The influence of the anisotropy on the important entities is numerically calculated and graphed. The method outlined for the transition to the exact solution is not restricted to the Milne Problem, therefore it can be transferred to multilayer problems in plane geometry. Author (NSA)

N67-24680# Stanford Univ., Calif. Linear Accelerator Center.

DESIGN CONSIDERATIONS FOR HIGH ENERGY ELECTRON–POSITRON STORAGE RINGS

B. Richter Nov. 1966 32 p Presented at the Intern. Symp. on Electron and Positron Storage Rings, Saclay, France

(Contract AT(04-3)-515)

(SLAC-PUB-240; CONF-660939-2) CFSTI: HC$3.00/MF$0.65

After a discussion on the importance of high energy electron–positron storage rings on progress in elementary particle physics, two design considerations are evaluated. The considerations are what luminosity (reaction rate per unit cross section) is required and what should be the maximum energy of the ring. NSA

N67-24684# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

RESIDUAL INTERACTION IN NUCLEI

Z. Bochnacki, I. N. Holban, and I. N. Mikhailov 1966 26 p refs

(JINR-E4-3034) CFSTI: HC$3.00/MF$0.65

The residual interaction in nuclei is introduced through the self-consistency conditions for the single-particle potential of the generalized Hartree–Fock method. The general features of the interaction are discussed, and its explicit form is derived for some realistic models giving the single-particle potential in finite nuclei. Author (NSA)

N67-24686# Oak Ridge National Lab., Tenn.

PSEUDO-ATOM PHASE SHIFTS OF LIQUID METALS AND ALLOYS

Axel Meyer, C. W. Nestor, Jr., and W. H. Young (Sheffield Univ.) [1966] 20 p refs

(Contract W-7405-ENG-26)

(ORNL-P-2569; CONF-660935-1) CFSTI: HC$3.00/MF$0.65

Ziman pseudo-atom phase shifts have been evaluated, as functions of 1 and k_F, for monovalent ions, using a pseudopotential technique. The results of their application to a number of physical problems suggest that the data are reasonably accurate. Author (NSA)

N67-24687# Argonne National Lab., Idaho Falls, Idaho.

TABLES OF DIFFERENTIAL CROSS SECTIONS FOR SCATTERING OF NEUTRONS FROM VARIOUS NUCLEI

R. O. Lane, A. S. Langsdorf, Jr., J. E. Monahan, and A. J. Elwyn [1967] 226 p

(Contract W-31-109-ENG-38)

(ANL-6172) CFSTI: HC$3.00/MF$0.65

Experimental values of the neutron differential scattering cross sections of ^{9}Be, Ca, ^{12}C, Pb, Li, ^{6}Li, ^{7}Li, ^{16}O, Si, S, and Sn are tabulated, together with values obtained by a least-squares fitting of the data, and the error matrix resulting from the least-squares calculation. NSA

N67-24688# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

ONE-PARTICLE LEVELS OF THE AVERAGE FIELD IN DEFORMED NUCLEI [ODNOCHASTICHNYE UROVNI SREDNEGO POLYA DEFORMIROVANNYKH YADER]

F. A. Gareev, S. P. Ivanova, and B. N. Kalinkin 1966 22 p refs In RUSSIAN; ENGLISH summary

(JINR-P4-2976)

A method is suggested to solve the Schrödinger equations with a diffusion potential which allows calculation of the energies and the analytical wave functions of single-particle states of a deformed axially symmetric nucleus. Author (NSA)

N67-24689# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

DISPERSION SUM RULES FOR π p-SCATTERING AND Kp-SCATTERING [DISPERSIONNYE PRAVILA SUMM DLYA π p- I Kp-RASSEYANII]

V. I. Zhuravlev and K. V. Rerikh 1966 9 p refs In RUSSIAN; ENGLISH summary

(JINR-P2-3081)

An analysis was made of dispersion sum rules, obtained in the work by Logunov, Soloviev, and Tavkhelidze, which connect the high-energy scattering parameters with the integrals of low-energy cross sections. Author (NSA)

N67-24690# Aarhus Univ. (Denmark).
TEMPERED DISTRIBUTIONS IN INFINITELY MANY DIMENSIONS. III. LINEAR TRANSFORMATIONS OF FIELD OPERATORS
P. Kristensen, L. Meulbo, and E. Thue Poulsen Nov. 1966 31 p refs
(NP-16460)

The linear homogeneous transformations of the canonical pair of field operators, in particular linear transformations induced by the real symplectic group over Schwartz's space, were investigated. NSA

N67-24692# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
BARYON RESONANCE PRODUCTION AND COLLINEAR SYMMETRIES [ROZHDENIE BARIONNYKH REZONANSOV I KOLLINEARNYE SIMMETRII]
P. Winternitz and M. A. Kasymzhanov 1966 8 p refs In RUSSIAN; ENGLISH summary
(JINR-P2-3069)

The reconstruction of the scattering matrix is considered for the collinear production of baryon resonances in baryon collisions. Predictions following from collinear symmetries are investigated. Author (NSA)

N67-24693# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Physics.
THE SUM RULE FOR THE FOUR PION COUPLING CONSTANT RESULTING FROM CURRENT ALGEBRA
Jan Kwiecinski Oct. 1966 7 p refs
(INP-498/PL) CFSTI: HC $3.00/MF $0.65

The sum rule for the off mass shell $\pi\pi$ scattering amplitude at the symmetry point $s=t=u=0$ is derived using the current algebra. (This amplitude is assumed to be approximately equal to the four pion coupling constant λ.) The sum rule is saturated by the appropriate single particle contributions. The obtained value $|\lambda| \cong 0.15$ is in agreement with the other predictions of this constant. Author (NSA)

N67-24694# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ELECTROMAGNETIC MESON–BARYON POLARIZABILITY IN QUARK MODEL [ELEKTRICHESKAYA I MAGNITNAYA POLYARIZUEMOSTI MEZANOV I BARIONOV V MODELI KVARKOV]
R. P. Zaikov 1966 9 p refs In RUSSIAN
(JINR-P2-3073) CFSTI: HC $3.00/MF $0.65

The relations between the coefficients of electric and magnetic polarizabilities of the mesons and baryons are obtained on the basis of nonrelativistic quark model. Some theoretical numerical estimates are given for the magnetic polarizabilities. Author (NSA)

N67-24695# Oak Ridge National Lab., Tenn.
EXTRACTION OF A BEAM OF HEAVY IONS ACCELERATED IN A STELLAR FIELD CYCLOTRON BY STRIPPING
Youri Oganessian, Andre Cabrespine, Emile Martin, Henri Sergolle, Denise Langlois et al [1966] 6 p refs Transl. into ENGLISH from Compt. Rend. Acad. Sci. (Paris), v. 262, 1966 p 1359–1362
(ORNL-TR-1469) CFSTI: HC $3.00/MF $0.65

A new device for the extraction of a beam, which permits a 100% yield, was investigated on the focusing sector and heavy ion cyclotron of Orsay. This process is applicable to incompletely ionized multicharged heavy ions and permits an extraction at variable energy as a function of the stripping radius. The internal beam of particles accelerated by a cyclotron in general is extracted by perturbing the radius of curvature of the peripheral path by an additional electric field (electrostatic deflection). The principle of the extraction device investigated consists of modifying the charge of the accelerated particle, which results in a sharp variation of the radius of curvature of its path. NSA

N67-24697# Utrecht State Univ. (Netherlands).
RESONANCES IN (p,αP AND (α,p) REACTIONS ON LIGHT NUCLEI
J. Kuperus (Ph.D. Thesis) 1965 70 p refs
(NP-16461) CFSTI: HC $3.00/MF $0.65

Resonances in the reactions $^{27}Al(p,\alpha)^{24}Mg$, $^{35}Cl(p,\alpha)^{32}S$, $^{37}Cl(p,\alpha)^{34}S$, $^{31}P(p,\alpha)^{28}Si$, and $^{23}Na(p,\alpha)^{20}Ne$ at 200 to 850 keV and in the reactions $^{27}Al(\alpha,p)^{30}Si$, $^{19}F(\alpha,p)^{22}Ne$, $^{31}P(\alpha,p)^{34}S$, and $^{23}Na(\alpha,p)^{26}Mg$ between 1.0 and 3.3 MeV were investigated. Resonance energies, spins, parities, strengths, and widths were obtained. NSA

N67-24698# Universidad Nacional Autonoma de Mexico, Villa Obregon. Facultad de Ciencias.
THEORETICAL ANALYSIS OF THE STRUCTURE OF ^{19}O NUCLEI [ANALISIS TEORICO DE LA ESTRUCTURA NUCLEAR DEL ^{19}O]
Fosado Penaloza and Mario Efren (Ph.D. Thesis) 1965 69 p refs In SPANISH
(NP-16415) CFSTI: HC $3.00/MF $0.65

On the basis of the nuclear shell model, the energy levels of the ^{19}O nucleus were calculated using as the residual interaction between the three nucleons outside the closed shell the interaction model which consists of a linear combination of a quadrupole–quadrupole interaction, pairing interaction, and spin-orbit interaction. The interaction thus expressed in second quantization language is calculated by means of basic techniques in group theory. Strictly only the second quantization technique is used in order to take into account the antisymmetry of the wave functions describing fermions so that the nucleon number is considered to be constant. The energy-level spectra calculated theoretically were compared with the experimental values, and the values of the parameters for the best fit were found. Author (NSA)

N67-24699# Lyon Univ. (France). Faculte des Sciences.
STUDIES OF QUASI-ELASTIC ANTIPROTON–PROTON INTERACTIONS AT 3 GeV/c [ETUDE DES COLLISIONS QUASI-ELASTIQUES ANTIPROTON–PROTON A 3 GeV/c]
Martial Doporto (Ph.D. Thesis) 25 Jun. 1965 36 p In FRENCH
(NP-16423) CFSTI: HC $3.00/MF $0.65

The collision of antiprotons with 3 GeV/c linear momentum was studied in order to examine the possibilities offered by the photographic emulsion technique and to determine what procedures can be most advantageously used to establish the collision kinematics. The mathematical study of the kinematics of quasi-elastic collisions led to expressions which, in principle, make it possible to determine the three compounds of the linear moment of the internal nucleon. The lack of precision of the data and the complexity of the equations obviated their use in the present study. The experimental study showed clearly the need for sufficient precision on the angular determinations, not a fundamental difficulty, but one which required that the distortion of the emulsions be small. There must be very good determination of the energy of the recoil proton. The energy of the incident particle must be well known as the measurement in the emulsion was impossible. NSA

N67-24700# Argonne National Lab., Ill.
ANGULAR DISTRIBUTION OF ^{232}Th 1.6-MeV NEUTRON FISSION FRAGMENTS
L. D. Smirenkina, S. B. Ermagambetov, G. N. Smirenkin, and A. S. Tishin [1966] 6 p refs Transl. into ENGLISH from Russian Rept. FEI-45
(ANL-TRANS-407) CFSTI: HC $3.00/MF $0.65

The angular distribution of fragments from the fission of ^{232}Th by 1.6-MeV neutrons was measured by the method of amorphous media (glass). Noticeable deviations from earlier measurements were established. An analysis of the experimental data revealed the inaccuracy of earlier identifications of the predominant fission channels of the ^{233}Th nucleus and established considerable uncertainties in the channel analysis connected with the insufficient knowledge of partial cross sections of the formation of compound nuclei. Author (NSA)

N67-24723# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

A 55-MOMENT SYSTEM OF DIFFERENTIAL KINETIC EQUATIONS [55-MOMENTNAYA SISTEMA DIFFERENTIAL'NYKH KINETICHESKIKH URAVNENIY]

R. G. Barantsev 31 Oct. 1966 18 p refs Transl. into ENGLISH from Aerodinamik Razrezhennykh Gazov, (USSR), no. 2, 1965 p 98–113

(FTD-HT-66-645; TT-67-60770; AD-646375) CFSTI: HC $3.00/MF $0.65

A differential equation system is obtained for the expansion coefficients of the distribution function in a monatomic rarified gas with respect to Hermite polynomials. This system contains moments up to the fifth order inclusive. The interest in these equations is supported by the desire to see general kinetic regularities in their structure, and it is not suppressed by the acknowledgement of the unreliability of their solution. From the cross section of the collision and the internal transform which characterize the mechanism of collisions between atoms, only four functionals remain in the obtained system. Author (TAB)

N67-24762# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

EFFECT OF COBALT-60 GAMMA RADIATION AND OF THERMAL NEUTRONS ON HIGH RESISTANCE P AND N SILICON. POSSIBILITY OF OBTAINING A NUCLEAR COMPENSATION FOR P TYPE SILICON [EFFETS DU RAYONNEMENT GAMMA DU COBALT 60 ET DE NEUTRONS THERMIQUES SUR DU SILICIUM P ET N DE HAUTE RESISTIVITE. POSSIBILITE DE REALISER UNE COMPENSATION NUCLEAIRE D'UN SILICIUM DU TYPE P]

Jean Messier (Ph.D. Thesis) 1966 96 p refs In FRENCH

(CEA-R-2918; PB-170543) CFSTI: HC $3.00/MF $0.65

Silicon N and silicon P were evaluated for the effects of cobalt 60 gamma radiation, and of thermal neutrons. Particle detection by means of semiconductors is reported. An extensive bibliography, and technical details are also presented on nuclear compensation of silicon P. Transl. by R.Li.

N67-24794# Delaware Univ., Newark. Electrical Engineering Dept.

ON THE QUANTUM STATISTICS OF MODE MIXING

L. F. Jelsma Aug. 1966 28 p refs

(Grant AF-AFOSR-2-65)

(Q61; AFOSR-67-0425; AD-647411) CFSTI: HC $3.00/MF $0.65

This is a semiclassical quantum formulation of mode mixing in nonlinear media employing Glaubers P-representation of the statistical density operator. Coupled mode equations are derived from Maxwell's equations and Hamiltonians are found which generate the coupled mode equations through Hamilton's equations of motion. The state of the system is determined by postulating that a maximum entropy state will be approached if all controlled sources are turned off. An expression representing the statistics of frequency conversion is derived and the noise in an up converter employing a quantum counter is determined. Author (TAB)

N67-24798# Boston Univ., Mass. Dept. of Physics.

QUANTUM THEORY OF MEASUREMENT IN RELATION TO A GENERAL THEORY OF OBSERVATION AND CONTROL Final Report, 1 Jul. 1965–31 Jun. 1966

Marcus C. Goodall Aug. 1966 60 p refs

(Contract AF 19(628)-5119)

(AFCRL-66-646; AD-646571) CFSTI: HC $3.00/MF $0.65

Part I discusses the unsolved logical problems of quantum mechanics insofar as they affect its interpretation as a theory of observation and control. In particular the notion of interpretive sets is introduced as a way of avoiding the strong atomicity postulate which is considered to be the essential source of these difficulties. A basic postulate underlying the theory of physical measurement is then that these sets satisfy a certain three-way symmetry principle. Part II is concerned with the consequences of this principle (Triality) for a semi-classical field theory, that is one that does not make explicit use of interpretive sets. It is indicated in Part I that a full development of this theory would require a sheaf-theoretic approach, where the geometric structure is supported by an algebraic one. Author (TAB)

N67-24875# Carnegie Inst. of Tech., Pittsburgh, Pa. Dept. of Physics.

GAMOW-TELLER BETA DECAY IN HEAVY SPHERICAL NUCLEI AND THE UNLIKE PARTICLE-HOLE RANDOM PHASE APPROXIMATION

John A. Halbleib, Sr. and Raymond A. Sorensen Jan. 1967 80 p refs Submitted for publication

(Contract Nonr-760(15))

(TR-27; AD-646749) CFSTI: HC $3.00/MF $0.65

Allowed Gamow-Teller beta decay rates are calculated for medium and heavy spherical nuclei with the use of the pairing plus quadrupole model with additional n-p forces. A schematic force of the form chi tau. tau sigma. sigma is found to be particularly important. A random phase approximation treatment of this force is developed and shown to be correct in the weak and strong coupling limits. The relation between the retarded beta decay rates and a supermultiplet structure is discussed. Author (TAB)

N67-24887# New York Univ., N. Y. Dept. of Physics.

ELECTRON SCATTERING Semiannual Technical Summary Report

B. Bederson, S. Borowitz, and L. Spruch 30 Sep. 1966 19 p

(Contract Nonr-285(60); ARPA Order 125)

(AD-646244) CFSTI: HC $3.00/MF $0.65

Experimental and theoretical atomic physics at New York University is described. The experimental work includes: (1) total low energy e-O and e-O2 cross sections; (2) Tensor Polarizabilities of metastable Hg; (3) threshold behavior of 4 doublet-P1/2,3/2 states of K by electron bombardment and state selection of K beam; (4) Cold (150K) microwave discharge atomic beam H source; (5) new e-molecule total cross-section and tensor polarizability apparatus; (6) new e-metastable rare gases total cross sections experiment; (7) Li beam Cs plasma interactions. The theoretical scattering work includes: (1) long range potentials and functions required in partial-wave effective range theory; (2) Variational lower and upper bounds on phase shifts; (3) variational bounds on parameters using Feynman formulation of Q.M.; (4) comparison of variational bound formalisms; (5) conditions for existence of bound states; (6) bounds on matrix elements; (7) collective oscillations of atoms. Author (TAB)

N67-24893# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DIRAC ELECTRON IN THE FIELD OF A PLANE ELECTROMAGNETIC WAVE

I. I. Gol'dman. 31 Oct. 1966. 11 p. refs. Transl. into ENGLISH from AN ARMSSR. Izv. Ser. Fiz.-Mathematiches. Nauk. (USSR), v. 17, no. 6, 1964 p. 129–135
(FTD-HT-66-286; TT-67-60684; AD-646292) CFSTI: HC $3.00/MF $0.65

Diracs equation for the electron in the outer field permits a precise solution only in a small number of cases, among which the most important ones prove to be a uniform magnetic field, a Coulomb field, and the field of a plane wave. In Section One a solution of Diracs equation is given for the case of an arbitrary plane electromagnetic wave based on the use of the projective matrices which leads to substantial simplifications. An important problem for the applications is breaking down the solutions into electron and positron states. It is clear that for the correct solution of this problem one requirement is quite insufficient so that this breakdown (division) coincides with the ordinary one when the field is absent. The equation shown proves to be invalid. In Section Two there is given a solution of this problem based on the consideration of a limited electromagnetic train (of waves). In (6) the planewave solution is used for computing the Compton dispersion of intense photon flows. In this situation the question arises about the orthogonality of the system of solutions of Diracs equation. The proof of the orthogonality of the solution obtained is presented in Section Three. Finally, Section Four the case of the monochromatic wave is discussed. Author (TAB)

N67-24903# American Meteorological Society, Boston, Mass.
EFFECT OF THE MOTION OF THE NUCLEUS ON THE FINE AND HYPERFINE STRUCTURE OF TERMS
L. Baerunaite, S. Zhvironaite, and V. K. Shugurov. Bedford, Mass., AFCRL, Nov. 1966. 11 p. refs. Transl. into ENGLISH from Vilniaus Valstybinio Univ. Mokslo Darbai, Mat. Fiz. (USSR), v. 25, no. 8, 1958 p. 109–115
(Contract AF 19(628)-3880)
(TR-622; AD-646618) CFSTI: HC $3.00/MF $0.65

Formulas to allow for the effect of motion of the nucleus on the fine and hyperfine structure are derived. Numerical results, including the isotope shift in the fine structure, are given for the carbon atom in the ground configuration. Author (TAB)

N67-24905# Illinois Univ., Urbana. Dept. of Physics.
RESONANCE POLES IN A SIMPLE MODEL OF S WAVE PSEUDOSCALAR MESON BARYON SCATTERING
R. K. Logan and H. W. Wyld, Jr. [1967] 17 p. refs. Sponsored by ONR
(Grant NSF GP-6198)
(AD-646614) CFSTI: HC $3.00/MF $0.65

In an earlier work (see AD-636 763) a numerical calculation was made of S wave pseudoscalar meson baryon scattering in a simple broken SU(3) model based on a static vector meson exchange potential and coupled channel Schrodinger equation. In the present work these calculations are extended to finding the location of the poles of the scattering matrix in the multisheeted complex energy plane and the motion of these poles as the strength of the potential is varied. Particular attention is paid to the behavior of the poles when the potential strength is such that there is a resonance close to a threshold. Author (TAB)

N67-24912# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
SENSITIZED LUMINESCENCE IN IRRADIATED NOBLE GAS SYSTEMS Final Report, 22 Oct.–9 Nov. 1964
L. W. Sieck and J. A. Llewellyn (Florida State Univ.) Sep. 1966. 23 p. refs
(ARL-66-0180; AD-646604) CFSTI: HC $3.00/MF $0.65

The report describes investigations of collision induced luminescence phenomena in high pressure argon and krypton containing trace amounts of N2 and O2 using nominal 2.5 Mev electrons as the primary energy source. High resolution spectroscopy demonstrates that the C triplet-pi state of N2 is produced by quenching of the set of argon levels corresponding to approximately 11.5 ev of excitation energy. Evidence is also presented for the occurrence of the reaction N2 (B triplet-pi-g + O2 (X triplet-Sigma-g-) to NO (A double-Sigma +) + NO (X doublet-pi). Author (TAB)

N67-24915# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INTERACTION OF ELEMENTARY PARTICLES WITH A GRAVITATIONAL FIELD IN THE GENERAL THEORY OF RELATIVITY AND IN GENERALIZED LINEAR THEORY OF GRAVITATION
M. P. Korkina. 30 Sep. 1966. 17 p. refs. Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 10, no. 5, 1965 p. 497–507
(FTD-66-177; TT-67-60851; AD-646518) CFSTI: HC $3.00/MF $0.65

The interaction is compared of a gravitational field with electromagnetic and electron-positron fields respectively, as well as the self-interaction of a gravitational field in the general theory of relativity and in a generalized linear theory of gravitation. The generalization of linear theory of gravitation amounts to taking into account the intrinsic nonlinearity of the gravitational field. The above-mentioned interactions are identical in both theories up to the second approximation in the gravitational constant alpha. If there are any discrepancies, they must be sought in the higher approximations. It is also shown that the linear approximation of the general theory of relativity contains, just as the linear theory of gravitation, arbitrary constants, and that Gupta's formulation is a particular case of the linear approximation of the general theory of relativity. The above method of analysis of the interaction with a gravitational field greatly simplifies the calculations and makes it possible to use flat metrics in all the approximations of the theory. Author (TAB)

N67-24978# RAND Corp., Santa Monica, Calif.
VERIFICATION OF AN APPROXIMATE FORMULA FOR MULTIPLE SCATTERING OF SLOW ELECTRONS
Harriet Kagiwada and Robert Kalaba. Feb. 1967. 15 p. refs
(Contract F44620-67-C-0045; Proj. RAND)
(RM-5276-PR; AD-647183) CFSTI: HC $3.00/MF $0.65

Verification of an approximate formula recently proposed by two Russian authors for the multiple scattering of slow electrons in a gas. This study shows how the true solution can be computed accurately and makes comparisons to determine the range of validity of the approximate formula. For the precise calculation of the reflected flux, the reflection function r (z,u,x) is introduced in analogy with radiative transfer theory, and r is computed very accurately as the solution of an initial value problem for ordinary differential equations. Then the reflected flux is computed via quadrature and compared with the Russian formula. It is found that the approximate formula for the reflected flux is remarkably accurate and may be useful for predicting average reflected densities. The distribution function at the top, however, is poorly represented in the Russian formulation. Regarding internal distribution, it is concluded that the cosine pattern is found for medium to great thickness, while the cosine pattern is a poor approximation for thinner media. Author (TAB)

N67-24981# United Nuclear Corp., Elmsford, N. Y. Research and Engineering Center.
UNC-RAM-2: A FORTRAN MONTE CARLO PROGRAM TREATING TIME-DEPENDENT NEUTRON AND PHOTON TRANSPORT THROUGH MATTER

Eugene S. Troubetzkoy Sep. 1966 97 p refs
(Contract DA-30-069-AMC-785(X))
(UNC-5157; AD-647470) CFSTI: HC$3.00/MF$0.65

UNC-SAM-2, the second United Nuclear Corporation Stochastic Approximation Method, is a code system in the FORTRAN language for evaluating the time dependence of the transport of neutrons or photons through matter using Monte Carlo techniques (see also AD-605 458). This program represents the latest result of a continuing effort to develop Monte Carlo programs which will handle complex geometrical configurations with improved versatility and speed. TAB

N67-24994# American Meteorological Society, Boston, Mass.
ENERGY LEVELS AND ISOTOPE SHIFTS OF TERMS FOR EXCITED STATES OF ATOMIC SPECIES OF HELIUM TYPE [ENERGETICHESKIE UROVNI I IZOTOPICHESKOE SMESHCHENIE TERMOV VOZBUZHDENNYKH SOSTOIANII ATOMOV TIPA GELIIA]
A. I. Kantseriavichius Bedford, Mass., AFCRL, Nov. 1966 26 p refs Transl. into ENGLISH from Tr. Akad. Nauk Lit. SSR, Ser. B. (USSR), v. 3, no. 26, 1961 p 107–124
(Contract AF 19(628)-3880)
(T-R-602; AD-646674) CFSTI: HC$3.00/MF$0.65

The energy levels of excited states of the helium-like atomic species from He to O(6+), the mass effect and relativistic corrections to the energies of several levels, and isotope shifts of terms are determined on the basis of analytic orbitals. The multiconfiguration approximation is applied to the S terms with n = 2, 3, and the effectiveness of this technique of refinement of an orbital is examined in the determination of the aforementioned quantities. The theoretical data are compared with the available experimental data and with the analogous data of other authors. Some ideas about the accuracy of these data are presented. Author (TAB)

N67-25009* International Information, Inc., Philadelphia, Pa.
SOLUTION OF THE EQUATION OF DEGRADATION OF γ-RADIATION ENERGY [K RESHENIYU URAVNENIYA DEGRADATSII ENERGII γ-IZLUCHENIYA]
V. A. El'tekov Washington, NASA, Feb. 1967 7 p refs Transl. into ENGLISH from Vestn. Mosk. Univ. (Moscow), no. 4, 1966 p 15–19
(Contract NASw-1499)
(NASA-TT-F-10627) CSCL 20H

Numerical methods of solving the integral equation of γ-quanta scattering are discussed. A new method is proposed for solving this equation and a number of its advantages over the usual methods are indicated. Author

N67-25025*# National Aeronautics and Space Administration, Washington, D. C.
COMBINED APPROXIMATION METHOD FOR ENERGY CALCULATION IN THE MANY-ELECTRON PROBLEM [EIN KOMBINIERTES NAEHERUNGSVERFAHREN ZUR ENERGIEBERECHNUNG IM VIELELEKTRONENPROBLEM]
H. Hellmann Apr. 1967 23 p refs Transl. into ENGLISH from Acta Physicochimica (URSS), v. 1, no. 6, 1935 p 913–914
(NASA-TT-F-10848) CFSTI: HC$3.00/MF$0.65 CSCL 20H

An approximation formula for the quantum-mechanical many-body problem is developed for the energy calculation of many-electron configurations, based on utilization of spectroscopic data for quantitative chemical analyses. The method is a combination of the Thomas–Fermi statistical distribution and the Schrödinger equation, applying the former to the atom rumpf and the latter to the valence electrons. Application of the method to the binding energy of K_2 yields only 37% of the true energy and 39% for KH, with the main reason for the energy deficiency being neglect of the orbital motion coupling of electrons due to their interaction. Mathematical development of the method is given for the K_2 and the KH molecule as typical examples. Author

N67-25028*# National Aeronautics and Space Administration, Washington, D. C.
VARIATIONAL PRINCIPLE FOR THE INTENSITY OF FORBIDDEN TRANSITIONS [VARIATSIONNYY PRINTSIP DLYA INTENSIVNOSTI ZAPRESHCHENNYKH PEREKHODOV]
Yu. Yu. Dmitriyev and M. S. Yur'yev Feb. 1967 6 p refs Transl. into ENGLISH from Vestn. Leningr. Univ., Ser. Fiz. i Khim. (Leningrad), v. 21, no. 16, 1966 p 26–29
(NASA-TT-F-10619) CFSTI: HC$3.00/MF$0.65 CSCL 20H

Mathematical expressions are developed for the variational principle, and the stationary value of the given functional is taken as the matrix element for the transition. The variational problem for computing the form of maximum and minimum problems are formulated. It is concluded that this variational principle makes it possible to calculate approximately the probability of forbidden transitions, which are allowed in the first order perturbation theory. N.E.N.

N67-25056*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
EFFECTIVE RESONANCE INTEGRALS OF SEPARATED TUNGSTEN ISOTOPES
Donald F. Shook and Donald Bogart Washington, NASA, May 1967 33 p refs
(NASA-TN-D-3957) CFSTI: HC$3.00/MF$0.65 CSCL 18K

Measurements of effective resonance integrals for separated tungsten isotopes enriched in tungsten 182, 183, 184, and 186, and for natural tungsten were made relative to gold. The effective integrals were determined by using a small homogeneous reactor to measure epicadmium reactivities for samples of various sizes located at the center of the core. For comparison with the reactivity data, relative γ-ray activities of cadmium-covered thin samples of gold were also determined. The experimental results were compared with effective resonance integral calculations by using the Nordheim integral method and recently measured isotopic resonance parameters. Agreement between the calculations and experimental results for tungsten 182, 183, and 184 were generally good. However, for the tungsten 186 samples and for thick samples of natural tungsten, the calculations overestimated experimental effective integrals by 10 to 20 percent. For tungsten 186, the use of a radiation width of 44±4 millivolts for the highly scattering 18.8 electron-volt resonance brought calculations and experiment into better agreement. For natural tungsten, the experimental results indicated the presence of overlap effects for resonances of constituent isotopes. Author

N67-25057*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
MODELS FOR THE ANALYSIS OF CN VIOLET RADIATION BEHIND SHOCK WAVES IN AIR CONTAMINATED WITH CARBON-BEARING COMPOUNDS
John E. Nealy Washington, NASA, May 1967 27 p refs
(NASA-TN-D-3935) CFSTI: HC$3.00/MF$0.65 CSCL 07D

Techniques for analyzing the effects of contamination radiation from the CN violet band system behind normal shock waves are presented. The problem is approached in two ways: (1) a simple chemical system is set up for a known contaminant, and (2) a computer program which utilizes a free-energy minimization technique is used to evaluate the CN particle concentration for given atom percentages of carbon. Equilibrium radiation from CN and air with various contamination levels is determined for shock velocities ranging from 20,000 to 44,000 ft/sec (6.10 to 13.41 mm/μsec) at free-stream pressures of 0.1 to 1 mm Hg. Radiation from CN in the chemical relaxation zone behind a normal shock with C_2N_2 as the free-stream contaminant is also considered. Results of the calculations are presented graphically and discussed. Author

N67-25059*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ELECTRON TRANSMISSION THROUGH THICK SILICON TARGETS
Jag J. Singh Washington, NASA, May 1967 28 p refs
(NASA-TN-D-3927) CFSTI: HC $3.00/MF $0.65 CSCL 20H

Results of some recent measurements on angular and energy distribution of fast electrons transmitted through silicon targets of thicknesses varying from about 10 percent to 50 percent of the mean range are compared with theoretical calculations based on the Goudsmit–Saunderson treatment of multiple coulomb scattering of electrons. Effects of fluctuations of collision losses of the incident electrons have been included in the theory. It is concluded that the presently available theoretical calculations predict a somewhat lower value of the width of the transmitted electron spectra than measurements indicate. Author

N67-25071*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
QUARK MODEL OF LEPTONS
Jonas Stasys Zmuidzinas 1 May 1967 14 p refs
(Contract NAS7-100)
(NASA-CR-83743; JPL-TR-32-1082) CFSTI: HC $3.00/MF $0.65 CSCL 20H

A model is proposed in which leptons are deeply bound states of certain combinations of quarks and quirks (R-conjugates of quarks), as well as of their antiparticles. The mass splittings of the leptons are estimated using the static model with unitary-symmetric meson exchange forces and are found in rough agreement with experiment, provided one uses the quark mass differences implied by the quark model of hadrons. A new charged spin-1/2 lepton, $\lambda^{\pm}$, is predicted with mass $\geq M_{pion}$. Weak interactions of known leptons and $\lambda^{\pm}$ are examined from the viewpoint of the model. The electromagnetic decay $\mu \rightarrow e + \gamma$ is strictly forbidden. Rough dynamical arguments are presented to explain why leptons should be devoid of strong interactions. Author

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N67-23516# Innsbruck Univ. (Austria). Inst. for Theoretical Physics.
LITERATURE SURVEY ON PLASMA INSTABILITIES
F. Cap, H. Falser, H. Friedel, F. Herrnegger, and K. Lackner 1 Oct. 1966 41 p refs
(Contract AF 61(052)-675)
(AFOSR-66-2705; SR-36; AD-642936) CFSTI: HC $3.00/MF $0.65

In order to prepare for planned work on plasma instabilities, a search was made of the literature. The report gives a survey on the material found. A short review is given of the various points of view under which the theoretical approach is possible. Interchange instabilities are then treated, which cover the largest field of phenomena, among them the so called negative V-systems and ballooning modes. The influence of finite resistivity and current-carrier mass is next considered. A unified approach to resistive and microinstabilities completes the survey. TAB

N67-23548# United Kingdom Atomic Energy Authority, Culham (England).
BEHAVIOR OF CHARGED PARTICLES IN A TOROIDAL MAGNETIC FIELD
Koji Uo Sep. 1966 44 p refs
(CLM-R-67) HMSO: 6s

The motion of a charged particle in a Tokomak-type magnetic field is analyzed. By using the ϕ component of the canonical angular momentum in the toroidal coordinate system (r,θ,ϕ) and the total energy as the constants of motion, the region of allowed particle motion has been calculated. This region is given by a function of the ϕ-component of the magnetic vector potential A_ϕ, the vertical magnetic field, the electric field and the initial position and motion of the particle. Then the allowable range of energy and velocity of the particle to be confined within a limiting surface is determined. For given initial position of the particle, the maximum energy of the confined particle shows strong dependence on $\gamma \equiv (v_\phi)$ initial/v, and strong asymmetry on the sign of γ. The energy and the velocity distributions of the confined particles have strong radial dependence. In the region near the limiting surface, almost unidirection ϕ motion is allowed for ions. This stems from the fact that the θ component of the magnetic field is the effective agent for single-particle confinement in the toroidal system. The effect of the vertical and radial electric field is discussed. The vertical field is unfavorable for the particle confinement and the radial favorable. Author (NSA)

N67-23552# California Univ., Livermore. Lawrence Radiation Lab.
STRUCTURE AND GENERATION OF PLASMA BLOBS IN A COAXIAL INJECTOR WITH IMPROVED ELECTROTECHNICAL PARAMETERS AND VACUUM CONDITIONS
G. N. Aretov, M. I. Pergament, M. M. Stepanenko, and A. I. Yaroslavskii Sep. 1966 27 p refs Transl. into ENGLISH from IAE-1017 I. V. Kurchatow Inst. of Atomic Energy (Moscow), 1965 18 p
(UCRL-TRANS-10066) CFSTI: HC $3.00/MF $0.65

The results are presented of investigations into the initial stages of the discharge and the motion of plasma blobs in a coaxial injector in an apparatus operated with oil-free evacuation of the vacuum system. On the basis of a comparison between data from various procedures, conclusions are drawn about the motion of a current layer in different modes of operation of the accelerator, about the nature of the spreading of the plasmoids with currents carried away in field-free space, and about the cause of contamination of the plasma. Author (NSA)

N67-23553# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
ELECTROSTATIC STABILITY OF PLASMAS OF FINITE LENGTH. 'FLUTE' INSTABILITIES [STABILITE ELECTROSTATIQUE DES PLASMAS DE LONGUEUR FINIE. INSTABILITIES EN 'FLUTES']
Michel Cotsaftis Oct. 1966 24 p refs In FRENCH
(CEA-R-3089; EUR.-3139.F)

The full dispersion relation is written for "flute" instabilities, in the simplest case of slab geometry with an equilibrium state taking into account: the finite length (along z direction) of the plasma, and any cold plasma between this plasma and conducting plates at a finite distance of the symmetry plane of the system. The exact equations of the stability limit are deduced with the usual physical hypothesis of finite Larmor radius and zero gradient, but with the gravity term, which write in general as a set of curves relating two dimensionless parameters $\bar{\epsilon}_1$ and K, depending on another dimensionless parameter A, the expressions all of which are given. In this three-parameters set of curves is contained all the information needed for the study of the electrostatic stability of a system. With respect to previous work of Babikin destabilizing terms are introduced which have been neglected though they can have important effects. It is shown, in particular, that electrostatic instabilities can exist even in magnetic walls, and it is verified that with the commonly used hypothesis there is no instability. Furthermore, it is found that transforming a magnetic bottle or a well into a sufficiently "deep" well, by adding a multipolar field, for instance, does not lead always to stabilization. NSA

N67-23554# Princeton Univ., N. J. Plasma Physics Lab.
KINETIC THEORY OF DRIFT-DISSIPATIVE PLASMA INSTABILITIES
A. A. Rukhadze and V. P. Silin Oct. 1966 38 p refs Transl. into ENGLISH from Akad. Nauk SSSR (Moscow). Presented at the Intern. Symp. Exptl. Theoret. Aspects Torroidal Confin., Princeton, N. J., 11–15 Jul. 1966
(Contract AT(30-1)-1238)
(MATT-TRANS-31) CFSTI: HC$3.00/MF$0.65

An analysis was made of almost all possible spectra of unstable oscillations in an inhomogeneous plasma, retained by a strong magnetic field, with the exception of long-wave oscillations, for which the conditions $k_\perp\rho_i << 1$ and $\nu_e >> (\omega, k_z v_{Te})$ are fulfilled, but $\nu_i >> (\omega, k_z v_{Ti})$. For convenience, the results of this analysis of oscillation spectra are presented in a general table, where the frequency spectra of unstable oscillations are shown, along with their growth increments, the role of electron and ion collisions in the development of the instability and the conditions for its stabilization by magnetic field line of force crossing. NSA

N67-23561# California Univ., Livermore. Lawrence Radiation Lab.
INVESTIGATION OF CURRENT BEAM INSTABILITY IN AN INHOMOGENEOUS PLASMA
N. S. Buchel'nikova, R. A. Salimov, and Yu. I. Eydel'man (Akad. Nauk SSSR, Novosibirsk) Sep. 1966 35 p refs Transl. into ENGLISH from the Russian preprint, 1965 28 p
(UCRL-TRANS-10067) CFSTI: HC$3.00/MF$0.65

Instability developing in a nonuniform (with respect to density) highly ionized potassium plasma when a current is passed through it was studied. Experiments were conducted with magnetic fields of 400 to 2000 Oe and plasma densities of 10^9 to 10^{10} cm^{-3}. The plasma was collisionless. In accordance with what has been shown earlier, universal instability, appearing as the excitation of drift waves, occurs in the absence of current flow. In the presence of current flow two oscillatory branches are excited, one representing drift waves and the other ion-acoustic waves. For the first branch the frequency of the oscillations is inversely proportional to the magnetic field. The waves have an azimuthal component; the azimuthal phase velocities of all the harmonics are the same. For the second branch, the oscillation frequency is independent of the magnetic field and varies inversely with the length of the system. The phase velocity of the longitudinal component practically coincides with the ion-acoustic velocity. The critical velocity of the drift of electrons relative to ions, at which ion-acoustic waves are excited, $\approx 2\times10^6$ cm/sec, is an order of magnitude lower than that computed for a uniform, almost isothermal plasma. During the excitation of current beam instability the diffusion coefficient increases by a factor of 1.5 to 2.5; diffusion begins to increase simultaneously with the amplitude of the oscillations. Author (NSA)

N67-23617# Brown Univ., Providence, R. I. Div. of Engineering.
EXPERIMENTS ON JOULE HEATING OF SHOCK-IONIZED AIR WITH PARTICULAR EMPHASIS ON THE BOUNDARY LAYERS OF THE ELECTRODES IN THE DISCHARGE CHAMBER
S. Selamoglu Sep. 1966 37 p refs
(Contract AF 49(638)-1295)
(AFOSR-66-2756; AD-645636) CFSTI: HC$3.00/MF$0.65

By means of selective heating of the electron gas, the conductivity of a gas can be made to exceed its equilibrium value at the same gas temperature. The method of Joule heating of the gas by a D. C. discharge was employed. All experiments were carried out with air in a 3 1/2 inch diameter shock tube. The gas behind the reflected shock develops an important thermal and viscous boundary layer at the walls of the electrodes, comprising the discharge chamber. The primary purpose of the experiments was to determine their effect on Joule heating of the air. The current density in the discharge chamber ranged from 300 to 7,000 A/sq cm. Due to the boundary layers, a current density in excess of 600-700 A/sq cm is required to efficiently heat the gas. Non-equilibrium conductivity measurements were made and compared with those computed theoretically. The distribution of voltage and current density between the electrodes was investigated. By photographing the current discharge, its stability and uniformity was determined. Author (TAB)

N67-23727# Oak Ridge National Lab., Tenn.
MAGNETOHYDRODYNAMIC STABILITY ANALYSIS OF JET-INJECTION FLOW OVER A CONCAVE WALL
T. S. Chang and W. K. Sartory [1966] 11 p Presented at Ann. Meeting, Am. Phys. Soc. Fluid Dyn. Div., Stanford, Calif.
(Contract W-7405-ENG-26)
(ORNL-P-2740; CONF-661111-2) CFSTI: HC$3.00/MF$0.65

The theoretical portion of this investigation consists of two parts: a calculation of the primary velocity profile in a jet-driven vortex tube, and an MHD stability analysis of the resulting flow. The primary flow is observed experimentally to consist of a thin boundary layer near the outer tube wall in which the influence of the driving jets and viscous wall drag are felt, and an interior region in which angular momentum is conserved. This investigation is concerned mainly with the outer boundary layer in which the flow is essentially two-dimensional and unaffected by the magnetic field. Author (NSA)

N67-23772# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
USE OF MICROWAVE COMPONENTS AT HIGH TEMPERATURES FOR MEASUREMENTS IN PLASMA PHYSICS [COMPONENTI A MICROONDE FUNZIONANTI AD ALTA TEMPERATURA PER MISURE NELLA FISICA DEI PLASMI]
F. Garosi and A. Neri 1966 20 p refs In ITALIAN
(RT-ING-(66)-8) CFSTI: HC$3.00/MF$0.65

The characteristics of microwave components are given that have been used in a range of very high temperatures (1,500 to 2,500°K) to study the properties of uniform alkali plasmas produced in incandescent containers. The results obtained by using such components in experimental investigations on the interaction of alkali plasmas with electromagnetic radiation (8 to 10 GHz) are also reported. Author (NSA)

N67-23774# Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics.
INVESTIGATION OF UNIVERSAL PLASMA INSTABILITIES Quarterly Report, Sep. 1–Nov. 30, 1966
30 Nov. 1966 10 p refs
(Contract AT(40-1)-3405)
(ORO-3405-10) CFSTI: HC$3.00/MF$0.65

Construction properties of the thermal plasma device (Q machine) being built at the University of Maryland are discussed. The vacuum chamber, magnets, and the experimental platform are discussed. NSA

N67-23776# Maryland Univ., College Park. Dept. of Physics and Astronomy.
APPLICATIONS OF LIGHT SCATTERING TO PLASMA DIAGNOSTICS
Hans R. Griem Dec. 1966 8 p refs
(Contract AT(40-1)-3393)
(ORO-3393-2) CFSTI: HC$3.00/MF$0.65

A low energy but large diameter theta pinch is described. The resulting plasma has been used to compare Thomson scattering measurements of electron temperatures with spectroscopic estimates based on time histories of impurity line intensities. Further

measurements were concerned with initial plasma conditions for the compression phase, and some consideration was given to light-scattering measurements when the number of particles in the Debye sphere is small. Author (NSA)

N67-23778# Universidad Nacional Autonoma de Mexico, Villa Obregon.

THEORY OF SPECTROSCOPIC PLASMA DIAGNOSTICS [TEORIA DEL DIAGNOSTICO ESPECTROSCOPICO DE PLASMAS]

Homero Jimenez Dominguez 1965 144 p refs In SPANISH (NP-16443) CFSTI: HC $3.00/MF $0.65

The theory of spectroscopic plasma diagnostics is studied. Some characteristics of ionized gases and phenomena occurring under thermal equilibrium conditions are described. The black body radiation emitted by optically thick plasmas is considered. A formula for the determination of the temperature which characterizes the plasma is derived using as measured data the radiation in the optically thick parts of the spectra. Phenomena occurring within an ionized gas are then considered and expressions explaining quantitatively these phenomena are presented. The broadening of the spectral lines, both natural broadening and Doppler broadening, are considered up to the broadening caused by pressure. This last mode is visualized from two apparently independent viewpoints: the collisional and the statistical. A simple manner for deriving the two viewpoints, using a common point of origin, is presented. A resume is given of the expressions utilized to determine the plasma parameters spectroscopically and the manner in which these are applied. NSA

N67-23779# Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands). Instituut voor Plasma-Fysica.

REFLECTION OF ELECTROMAGNETIC WAVES BY A COLD MAGNETOPLASMA

F. W. Sluijter Oct. 1966 120 p refs (NP-16466) CFSTI: HC $3.00/MF $0.65

The propagation of monochromatic, linearly polarized, plane electromagnetic waves in a cold electron plasma is studied theoretically. The direction of propagation is taken perpendicular to a static magnetic field. Wave equations for both the ordinary and extraordinary wave modes are derived by linearization. Starting from a non-zero temperature conditions are evaluated under which its effect may be neglected. For that purpose the equations are supplemented with an adiabatic equation of state. Reflection and transmission coefficients are given for both directions of propagation of the incident wave. The wave equation for the extraordinary wave mode reduces for normal incidence to Heun's equation. This case includes the possibility of a local resonance somewhere in the density profile, i.e., the case of Budden tunneling. Wave propagation in a homogeneous plasma is next considered. Starting from the nonlinear cold plasma equations expressions are derived for the lowest order corrections to the well-known solution of the linearized equations. Expressions are evaluated for forced waves due to the interaction of two ordinary waves, to the interaction of an ordinary and an extraordinary wave, and for the forced wave due to an extraordinary wave alone. Author (NSA)

N67-23780# California Univ., Livermore. Lawrence Radiation Lab.

DYNAMICS OF A GYROVISCOUS PLASMA

William A. Newcomb 28 Jun. 1966 30 p refs (Contract W-7405-ENG-48) (UCRL-14466, Rev. 1) CFSTI: HC $3.00/MF $0.65

A collisionless plasma in a strong magnetic field is well known to exhibit a reactive type of viscosity (as opposed to a resistive type), which will be referred to here as the gyroviscosity. A systematic dynamical theory is developed for the gyroviscous plasma. For continuous fluids in general, and for plasmas in particular, there are two natural ways of defining the fluid velocity. There is first the observed velocity of a test particle, say a radioactive tracer ion, which presumably is carried along with the fluid, and there is also the momentum per unit mass, with electromagnetic corrections if necessary. In the case of the gyroviscous plasma these two velocities are not the same, but they are related to each other in a symmetrical way. There is, in short, a duality theorem according to which the dynamical equations are invariant under the exchange of the two velocities if at the same time the direction of the magnetic field is reversed. There is a third natural velocity midway between the other two. If the dynamical equations are written terms of this third velocity, then the gyroviscous force is derivable from a potential-energy function. Author (NSA)

N67-23784# Naval Ordnance Lab., Corona, Calif.

PLASMA PHYSICS. COHERENT EXCITATION OF ATOMS

T. Hadeishi *In its* Foundational Res. Proj. 1 Dec. 1966 p 25-33 refs (See N67-23781 12-23)

The coherent excitation of atoms is discussed, and a mathematical interpretation given of the means by which this can be accomplished. Experimental methods used to observe the coherently excited states are described. Author

N67-23826# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PECULIARITIES OF BURNING OF ELECTRIC ARC IN PLASMATRONS AND SIMILARITY CRITERIA

M. F. Zhukov 30 Jun. 1966 38 p refs Transl. into ENGLISH of the Publ. 'Osobennosti Goreniyz Elektricheskoy Dugi V Plazmotronakh i Kriterii Podobiya" Moscow, Inst. Teor. i Prikl. Mekhan., 1965 p 1-44 (FTD-MT-65-532; TT-67-60287; AD-644033) CFSTI: HC $3.00/MF $0.65

Contents: Shunting of the electric arc, large- and small-scale pulsations; Character of motion of radial sections of arc; Relation between shunting, character of erosion of electrodes and volt-ampere characteristic; Polarity of connection of electrodes and peculiarities of arcing connected with this; Criterial generalization of characteristics of plasmatron. TAB

N67-23833# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THEORETICAL METHODS OF INVESTIGATION OF FREEZING OF CHEMICAL AND ELECTRONIC PROCESSES IN LOW-TEMPERATURE PLASMA JETS

G. S. Aravin, N. M. Kuzentsov, and Yu. S. Sayasov 30 Jun. 1966 15 p refs Transl. into ENGLISH of the Publ. "Teoreticheskiye Metody Issledovaniya Zakalki Khimicheskikh i Elektronnykh Protsessov v Nizkotemperaturnykh Plazmennykh Struyakh" Moscow, Inst. Khim. Fiz., 1965 p 1-9 (FTD-MT-65-546; TT-67-60312; AD-644073) CFSTI: HC $3.00/MF $0.65

Contents: General methods of investigation of processes of freezing gas jets; Chemical composition and gas-dynamic parameters of flow; Kinetics of electron-ion processes. TAB

N67-23838# Royal Inst. of Tech., Stockholm (Sweden). Microwave Dept.

NON-LINEAR COUPLING BETWEEN SLOW AND FAST WAVES IN A WAVE-GUIDE PARTIALLY FILLED WITH A PLASMA

P. Hedvall 1 Dec. 1966 30 p refs (Contract AF 61(052)-895) (SR-13; RADC-TR-67-39; AD-645747) CFSTI: HC $3.00/MF $0.65

The non-linear coupling between different modes in a parallel plate wave-guide, partially filled with a cold and homogeneous plasma slab, is studied. The types of non-linearities considered are those arising in the equation of motion for the electrons and from the ac charges on the plasma boundaries. It is shown that, by means of a slow (or fast) pump wave, one slow primary wave can non-linearly excite another fast wave, which in contrast to the slow primary wave will have a considerable amount of field energy outside the plasma, and may thus be easily picked up by conventional couplers. Numerical calculations of the coupling coefficient are presented, and it is concluded that non-linear coupling in this way, at least for very slow primary waves, can provide a means of getting an improved coupling to the slow plasma waves. Author (TAB)

N67-23847# University of Southern Calif., Los Angeles.
PLASMAS
In its [Solid State, Appl. Electromagnetics and Plasmas, and Inform. Sci.] 30 Sep. 1966 p 112–123 refs (See N67-23841 12-26)
(Grant NSF GK-1115)

The fraction of the incident power in a transverse wave which converted to the longitudinal electron wave in a plasma was studied for a frequency below the second electron cyclotron harmonic. The plasma was assumed to be nonuniform along the x direction but uniform along the y and z directions. A current density equation that included the effects of the ambipolar electric field and the anisotropy of the unperturbed velocity distribution was used to obtain coupling of the waves in the region of the plasma where the density was such that the hybrid resonance was satisfied. G.G.

N67-23848# University of Southern Calif., Los Angeles.
RADIATION AND DIFFRACTION OF ELECTROMAGNETIC WAVES
In its [Solid State, Appl. Electromagnetics and Plasmas, and Inform. Sci.] 30 Sep. 1966 p 124–129 ref (See N67-23841 12-26)
(Contract N123(60530)52008A; Grant AF-AFOSR-496-66)

Reported are studies on: (1) *Reflectional and Transmission of Electromagnetic Waves by a Moving Plasma Medium*—wave interaction with dispersive cold plasma moving parallel to the interface or moving perpendicular to the interface; (2) *Scattering Microwaves by a Reentry Vehicle*—microwave scattering by cylinder coated with an inhomogeneous and anisotropic plasma sheath; and (3) *Effects of the Movement of a Dielectric Slab on the Reflection and Transmission Characteristics of Electromagnetic Waves*—solution for plane waves emitted from moving dielectric slab, and frequency of the reflected waves as a function of the velocity of the moving medium. G.G.

N67-23865*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
TIME-DEPENDENT STRUCTURE OF ONE-DIMENSIONAL MAGNETIC COMPRESSION WAVES IN COLLISIONLESS PLASMAS. OBLIQUE AMBIENT MAGNETIC FIELD
Vernon J. Rossow Washington, NASA, May 1967 43 p refs
(NASA-TN-D-3947) CFSTI: HC $3.00/MF $0.65

Numerical analysis is made of the structure of one-dimensional unsteady magnetic compression waves propagating into collisionless plasmas when the ambient magnetic field is oblique to the wave direction. In the cases studied, both the subcritical and supercritical solutions changed continuously from one limiting situation to the other. A similarity rule was found for correlating the subcritical cases so that the two-parameter family of solutions in mass ratio and field angle were reduced to a single set. Author

N67-23877# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
IMPROVEMENT OF A METHOD OF RADIOWAVE SOUNDING GAS, HEATED BY A SHOCK WAVE
Yu. S. Lobastov 7 Oct. 1966 12 p refs Transl. into ENGLISH from the Russian
(FTD-TT-66-8; TT-67-60284; AD-644016) CFSTI: HC $3.00/MF $0.65

Several radio methods presently exist for studying the parameters of high temperature gas. An examination is made of their applicability when working in a shock tube. TAB

N67-23881# United Kingdom Atomic Energy Authority, Culham (England).
INTERACTION OF A PLASMA WITH A TRANSVERSE MAGNETIC FIELD
V. G. Zikov, N. G. Sinitsa, I. A. Stepanenko, and V. T. Tolok [1966] 11 p Transl. into ENGLISH from Plasma Phys. and Problems of Controlled Thermonuclear Fusion (Kiev), 1965 p 27–36
(NP-TR-1474; CTO-290) CFSTI: HC $3.00/MF $0.65

The motion of plasma jets in a transverse magnetic field was investigated. The dependence between the plasma velocity component perpendicular to the homogeneous magnetic field and the magnetic field strength was determined. NSA

N67-23882# United Kingdom Atomic Energy Authority, Culham (England).
COMPARISON OF THE ABSOLUTE INTENSITIES OF THE RADIATION OF A HIGH TEMPERATURE PLASMA IN THE VISIBLE AND SOFT X-RAY REGIONS
P. Bogen and J. Schlueter [1966] 6 p refs
(NP-TR-1489; CTO-320; JUL-381-PP)

Absolute measurements were made on the continuum intensity of the theta-pinch plasma in the visible and X-ray regions. The results indicate that, within an experimental error by a factor of 2, the measured intensity in the X-ray region can be attributed to pure bremsstrahlung. NSA

N67-23883# Los Alamos Scientific Lab., N. Mex.
IDENTIFICATION OF THE IONIC SPECIES IN A CESIUM PLASMA DIODE
W. H. Reichelt and L. Agnew [1966] 5 p refs Presented at the Thermionic Conversion Spec. Conf., Houston, Tex.
(Contract W-7405-ENG-36)
(LA-DC-8176; CONF-661116-2) CFSTI: HC $3.00/MF $0.65

The identification of the dominant ionic species in a cesium plasma diode has been experimentally determined as the atomic ion, Cs^+, rather than the often suggested molecular ion, Cs_2^+. Spectrographic measurements yielded electron densities, N_e, from the Stark broadening of the fundamental series lines of cesium and the atomic ion densities, N_i, from the radiative recombination spectrum leading to the 6P state. Within experimental uncertainty, for a broad range of diode operating conditions, $N_i = N_e$ and $N_i >> N(Cs_2^+)$. Author (NSA)

N67-23895# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France).
STUDY OF MICROINSTABILITIES DUE TO AN ANISOTROPIC VELOCITY DISTRIBUTION FUNCTION OF THE PARTICLES OF A HOMOGENEOUS PLASMA [ETUDE DES MICROINSTABILITIES LIEES A L'ANISOTROPIE DE LA FONCTION DE DISTRIBUTION DES VITESSES DES PARTICULES D'UN PLASMA HOMOGENE]
Francois Hennion Sep. 1966 75 p refs In FRENCH
(CEA-R-3074; EUR-3002.f) CFSTI: HC $3.00/MF $0.65

A study is made of instabilities in a plasma with an ion velocity distribution function of the form $f_{0i} = -1/2\pi\alpha_{T_i}\alpha_{\|_i}\,\delta(v_\perp - \alpha_{T_i})\,e^{-(v_\|^2/\alpha_{\|_i}^2)}$. The plasma is assumed to have finite dimensions limited by infinitely conductive boundary surfaces. A theoretical and numerical analysis of marginal stability locates the regions of stability as a function of several parameters; i.e., plasma length, ion anisotropy (τ) and electron temperature (T_e). A limiting plasma length

is found, below which the plasma is stable regardless of its density. For the parameters of the injection experiment M.M.I.I. at Fontenay-aux-Roses, it is found that the type of instabilities studied here should not occur. Author (NSA)

N67-23987 Max-Planck-Institut fur Physik und Astrophysik, Munich (West Germany).

DERIVATION OF THE QUANTUM VLASOV EQUATION AND DISPERSION RELATION OF A RELATIVISTIC ELECTRON GAS

D. Biskamp Feb. 1967 10 p refs

(MPI-PAE/PL 2/67) CFSTI: $3.00

The selfconsistent field equation (Vlasov equation) is derived for the one-particle Wigner function of a relativistic electron-positron gas. From the linearized form the dispersion relation for any quasi-equilibrium is obtained, which has already been derived for the special case of thermal equilibrium by Tsytovich. Author

N67-24161# Atomic Energy Commission, Oak Ridge, Tenn. Div. of Technical Information Extension.

PLASMA PHYSICS AND CONTROLLED NUCLEAR FUSION RESEARCH

1966 648 p refs Transl. into ENGLISH of Russian papers presented at the Conf. on Plasma Phys. and Controlled Nucl. Fusion Res., Culham, England, 6–10 Sep. 1965

(AEC-TR-6760) CFSTI: HC $3.00

Conference papers on magnetic wells, stability and diffusion, dynamic stabilization, pinches, plasma instabilities and interactions, closed-line systems, and plasma heating are presented. For individual titles see N67-24162–N67-24195

N67-24162# Atomic Energy Commission, Oak Ridge, Tenn. Div. of Technical Information Extension.

ACCUMULATION OF A HOT ION PLASMA IN PR-5

Yu. V. Gott, M. S. Ioffe, and E. E. Yushmanov *In its* Plasma Phys. and Controlled Nucl. Fusion Res. 1966 p 1–16 refs (See N67-24161 12-25)

Experimental results are reviewed on the accumulation of a hot ion plasma in a PR-5 adiabatic trap with a composite magnetic field. The method used for filling the trap with hot plasma was based on the assumption that by applying a high-frequency accelerating potential to a cold plasma column it would be possible to achieve intensive quasi-continuous internal injection of accelerated ions. It was concluded that the modified magnetron injection method, involving the acceleration of the ions from a cold plasma column by a high-frequency radial electric field, is sufficient to set up in PR-5 a plasma with high-energy ions and a density of $\cong 10^{11}$ cm^{-3} in a volume of $\cong 10^4$ cm^3. R.Ll.

N67-24163# Atomic Energy Commission, Oak Ridge, Tenn. Div. of Technical Information Extension.

PLASMA STABILITY IN A MAGNETIC MIRROR MACHINE WITH STABILIZING RODS

B. A. Trubnikov *In its* Plasma Phys. and Controlled Nucl. Fusion Res. 1966 p 17–36 refs (See N67-24161 12-25)

Consideration is given to axially nonsymmetrical systems of the mirror type with stabilizing rods, in a criterion for the stability of a plasma. Mathematical expressions are derived for the plasma physics concepts reviewed, and oscillograms are included to indicate the condition of plasma stability. A conclusion is based on the oscillation recorded by a plasma probe. R.Ll.

N67-24164# Atomic Energy Commission, Oak Ridge Tenn. Div. of Technical Information Extension.

CLOSED MINIMUM-B CONFIGURATIONS

L. S. Solovev and V. D. Shafranov *In its* Plasma Phys. and Controlled Nucl. Fusion Res. 1966 p 37–58 refs (See N67-24161 12-25)

The possibility is discussed of producing closed minimum-B configurations by comparatively simple means, such as a system of spatial magnetic axes. An investigation was conducted on magnetic field configurations satisfying the minimum requirement for which a high temperature plasma may be produced. A method of calculation is presented on the magnetic configurations in a system of toroidal magnetic surfaces. To set up a minimum-B in systems with spatial magnetic axes, it is sufficient to superimpose upon a longitudinal magnetic field a transverse magnetic field containing second and third harmonics whose amplitudes are of the order of 10% of the main longitudinal field. An advantage of these systems compared with those having untwisted lines is the stability of the magnetic surfaces due to the shear of the field lines. In contrast to a two- or three-turn stellarator wound into a torus, the conditions for stability of the plasma and of the magnetic surfaces are not incompatible. R.Ll.

N67-24165# Atomic Energy Commission, Oak Ridge, Tenn. Div. of Technical Information Extension.

PRODUCTION OF A HOT PLASMA IN OGRA-II BY THE INJECTION OF FAST HYDROGEN ATOMS INTO A MAGNETIC TRAP

L. I. Artemenkov, R. P. Vasilev, I. V. Galkin, I. H. Golovin, V. A. Khilkov et al *In its* Plasma Phys. and Controlled Nucl. Fusion Res. 1966 p 60–82 refs (See N67-24161 12-25)

To obtain dense hot plasma by the injection of fast particles into a magnetic trap, the OGRA-II injector was developed. A schematic depicts the main parametric operating conditions of the OGRA-II; the magnetic field, injection conditions, and diagnostic techniques are detailed to throw light on the part played by the stabilizing magnetic field during the accumulation of the plasma. Oscillograms are presented on stabilized conditions, as well as the injection current and diagnostic probe signals in unstabilized conditions. The attenuation of the cyclotron instability by the stabilizing field is also clearly evident from the absence of long-lived particles in the stabilized condition, and from the exponential decay of the plasma after stopping injection in a time corresponding to the charge exchange of protons with an initial energy of 75 keV. R.Ll.

N67-24166# Atomic Energy Commission, Oak Ridge, Tenn. Div. of Technical Information Extension.

CONTAINMENT OF A HIGH-TEMPERATURE PLASMA OBTAINED BY TURBULENT HEATING IN A TRAP OF COMPOSITE TYPE

V. A. Simonov, V. V. Abozovik, V. N. Mnev, and V. V. Ignatiev *In its* Plasma Phys. and Controlled Nucl. Fusion Res. 1966 p 83–103 refs (See N67-24161 12-25)

To attain conditions in which the main energy losses are determined by cooling the ions, techniques for producing a high electron temperature in the initial plasma were studied. In this connection, a method of producing a dense, hot electron plasma by turbulent heating in a direct discharge is described. The method consists in the injection of an intense flux of accelerated electrons into the plasma jet, and their subsequent capture in the trap as a result of beam instability. In a composite trap (with increasing field), in the absence of a gas envelope, a dense hot electron plasma decays at a rate several times smaller than in a mirror field. It was also seen that the decay of the dense, hot electron plasma in a composite field is slowed down in the presence of a gas envelope appreciably less dense than that required in a mirror field. R.Ll.

N67-24167# Atomic Energy Commission, Oak Ridge, Tenn. Div. of Technical Information Extension.

INSTABILITY AND THE MACROSCOPIC EFFECTS IN TOROIDAL DISCHARGES

B. B. Kadomtsev and O. P. Pogutse *In its* Plasma Phys. and Controlled Nucl. Fusion Res. 1966 p 104–122 refs (See N67-24161 12-25)

In an investigation of thermal insulation of a high temperature plasma, plasma stability in linear approximation was studied for toroidal discharge application. Such investigation showed that in an inhomogeneous plasma, in addition to the hydromagnetic instabilities, there also exists a wide range of drift instabilities related to the presence of drift currents. Consideration is given such instabilities as: current-convective (helical), inertial drift, and temperature drift. Concepts are also reviewed on macroscopic convection, and thermal conductivity and diffusion. From the point of view of macroscopic effects in toroidal discharges, the greatest threat is presented by the temperature driven drift instability which leads to a very large heat flux in the specified case. R.Ll.

N67-24168# Atomic Energy Commission, Oak Ridge, Tenn. Div. of Technical Information Extension.

ANOMALOUS ION DRIFT INTO THE "CONE OF LOSSES"

A. A. Galeev *In its* Plasma Phys. and Controlled Nucl. Fusion Res. 1966 p 123–138 refs (See N67-24161 12-25)

Instability due to a local anisotropy in the ion velocity distribution function was investigated. The concept of the presence of the cone of losses in the velocity distribution of the ions leads to the development of a strong instability. Linear and nonlinear plasma stability theories are reviewed. An analytic result is briefly outlined: only in a narrow interval of trap lengths is the plasma lifetime in the trap determined by the turbulent diffusion time of the ions in velocity space. In all other cases, for not very short lengths, the plasma drifts from the trap during the transit time between the magnetic mirrors. R.Ll.

N67-24169# Atomic Energy Commission, Oak Ridge, Tenn. Div. of Technical Information Extension.

COLLECTIVE INTERACTION OF MODULATED AND UNMODULATED BEAMS WITH A PLASMA

A. Berezin, Ya. B. Fainberg, L. I. Bolotin, G. P. Berezina, I. A. Bez'yazychnii et al *In its* Plasma Phys. and Controlled Nucl. Fusion Res. 1966 p 139–160 refs (See N67-24161 12-25)

The physical phenomena appearing upon the growth of beam instabilities and the determination of their basic quantitative characteristics (growth increments, energy transmitted from beam to plasma) were investigated. Experimental results are briefly outlined on the matter of determining the space increments for the growth of instabilities, determining the frequency spectra, and measuring the phase velocities of the excited waves. These results were found to be in good agreement with theory. For the interaction of a modulated electron beam with a plasma, the effectiveness of the interaction of a beam of charged particles with a plasma strongly increases with an increase in the percent modulation of the beam. In the case of initially unmodulated beams, the percent modulation is determined by the field strength of the excited oscillations which depend chiefly upon the initial amplitude of the perturbation, i.e., a slightly fluctuating field in the beam and plasma. Results are listed for the investigation of the interaction of pulsed electron beams with a highly ionized plasma. R.Ll.

N67-24170# Atomic Energy Commission, Oak Ridge, Tenn. Div. of Technical Information Extension.

INTERACTION OF HF WAVES AND PLASMA IN DELTA-2

S. N. Breus, V. N. Kurdyumov, M. L. Levin, S. M. Osovets, N. Ya. Popova et al *In its* Plasma Phys. and Controlled Nucl. Fusion Res. 1966 p 161–170 refs (See N67-24161 12-25)

To investigate the possibility of confining a plasma by a field of traveling waves, a DELTA-2 device was used. Experiments devoted to the study of quasi-stationary magnetic fields appearing during discharge as a result of an HF traveling field are reported. Measurements on the DELTA-2 device showed that under experimental conditions, a quasi-stationary longitudinal field appeared. R.Ll.

N67-24171# Atomic Energy Commission, Oak Ridge, Tenn. Div. of Technical Information Extension.

INTERACTION BETWEEN uhf RADIATION AND A TURBULENT PLASMA

A. I. Kislyakov, M. M. Larionov, and V. V. Rozhdestvenskii *In its* Plasma Phys. and Controlled Nucl. Fusion Res. 1966 p 171–186 refs (See N67-24161 12-25)

The ultrahigh frequency (uhf) conductivity for plasma was investigated. In the 8 and 4 mm wavelength ranges, the transmission of a signal through a plasma, the thermal radiation of the plasma, and its effect on the quality factor (Q) of the discharge chamber, considered as an ordinary large resonator, were observed. Simultaneously, the mean plasma density was determined from the attenuation of an atomic hydrogen beam passing through it. In the plasma investigated, a mechanism exists for braking electrons which is considered more effective than coulomb collisions with singly charged ions. As a result, there is an anomalously low conductivity and an anomalously high absorption coefficient in the uhf range. A high attenuation of the passing signal was observed for plasma densities well below the critical density. R.Ll.

N67-24172# Atomic Energy Commission, Oak Ridge, Tenn. Div. of Technical Information Extension.

INJECTION OF PLASMA BLOBS INTO A MIRROR TRAP WITH ADIABATIC PLASMA COMPRESSION: ASPA

A. P. Babichev, Ye. M. Buryak, Ye. F. Gorbunova, A. I. Karchevskii, and Yu. A. Muromkin *In its* Plasma Phys. and Controlled Nucl. Fusion Res. 1966 p 187–204 refs (See N67-24161 12-25)

The principal parameters of the adiabatic compression of plasma (ASPA) apparatus, which was built for the investigation of plasma compression in magnetic mirror traps, are reported. A mass spectrometric study was made of the composition and the energy distribution of the ion component of plasma in the titanium and coaxial injectors. The density of the plasma blobs through the mirrors was investigated for fields of up to 20 kOe. It was shown that the injected plasma blobs, both from the titanium and from the coaxial injectors, penetrated the magnetic mirrors relatively freely when the mirror field was parallel to the guiding field, but were prevented from penetrating the system in the case of the divertor field. The experiments showed that it is possible to cut off heavy components of injected plasma with the aid of a pulsed magnetic shutter producing regions with zero magnetic field and allowing the magnetic lines of force to reach the walls of the chamber. R.Ll.

N67-24173# Atomic Energy Commission, Oak Ridge, Tenn. Div. of Technical Information Extension.

PLASMA WITH RELATIVISTIC ELECTRONS IN A MAGNETIC MIRROR TRAP

G. I. Budker, V. I. Volosov, S. S. Moiseev, V. E. Palchikov, and F. A. Tsel'nik *In its* Plasma Phys. and Controlled Nucl. Fusion Res. 1966 p 205–217 refs (See N67-24161 12-25)

Certain favorable properties of a relativistic plasma, used in an ordinary trap with magnetic mirrors, are considered. In the case of a quasi-neutral plasma, the presence of relativistic electrons also improves the stability of the plasma. Besides stabilization of the plasma, relativistic electrons are reported as being used to heat a plasma's ions. It is stated that the only known way of creating a plasma with relativistic electrons is by injecting them into a trap from an external electron accelerator. Two methods are

described for the fast-electron accumulation in a trap with magnetic mirrors. In both cases the injection current was as high as 10 A, the injection time ≈2μsec. The lifetime of the electrons captured in the trap was determined solely by the scattering in the residual gas. The observed effects of electron current escaping along the axis of the trap were virtually independent of the residual gas pressure and magnetic field intensity. This result is satisfactorily accounted for by the above-discussed mechanism of the two beam instability. R.Ll.

N67-24174# Atomic Energy Commission, Oak Ridge, Tenn. Div. of Technical Information Extension.

DYNAMIC STABILIZATION OF A PLASMA COLUMN

D. V. Orlinskii, S. M. Osovets, and V. I. Sinitsin *In its* Plasma Phys. and Controlled Nucl. Fusion Res. 1966 p 218–231 refs (See N67-24161 12-25)

Using a damped oscillatory circuit, the dynamic stabilization of a plasma column was investigated. Experimental results indicate that the formation of the plasma column is possible only when the rate of rise of current flowing through the gas is sufficiently high. The interaction between the plasma column and the high frequency stabilizing field leads to stabilization of the column. Both direct observations of the unstabilized current-carrying column, and the results of the investigations of the stabilizing effect show that long-wave perturbations develop first which in an unstabilized column then change into short-wave perturbations. No short-wave perturbations develop at all when the long-wave perturbations are stabilized. This finding disagrees strongly with existing theories of the macroscopic stability of a current-carrying plasma column, and it would seem that the theory of these effects requires considerable refinement and, possibly, revision. R.Ll.

N67-24175# Atomic Energy Commission, Oak Ridge, Tenn. Div. of Technical Information Extension.

PLASMA EQUILIBRIUM IN A TORUS WITH HF FIELDS AND PLASMA HEATING RESULTING FROM THE DEVELOPMENT OF A POWERFUL BEAM OF "ESCAPING ELECTRONS"

R. A. Dermirkhanov, A. F. Korov, M. A. Stotland, N. I. Malykh, G. L. Khorasanov et al *In its* Plasma Phys. and Controlled Nucl. Fusion Res. 1966 p 232–249 refs (See N67-24161 12-25)

In an investigation of the macroscopic equilibrium of the plasma pinch, the problems of instability and very high temperature heating are considered. Attention is directed to plasma equilibrium in a torus and plasma heating as a result of the development of a powerful beam of escaping electrons. Experimental results indicate that the high-frequency rotating quadrupole field separates the plasma pinch located within the quasistationary toroidal magnetic field from the walls of the discharge chamber and maintains it in an equilibrium state. Following the superposition of a strong electric field on the plasma pinch, a current appears within the plasma which is ohmic in nature during the first few half-periods. It was also seen that while the ohmic current is in progress, a fast incorporation of energy into the plasma of the order of several tens of Joules appears. The large ohmic resistance cannot be explained by pinch excitation instability only, but requires the introduction of auxiliary mechanisms. R.Ll.

N67-24176# Atomic Energy Commission, Oak Ridge, Tenn. Div. of Technical Information Extension.

PLASMA HEATING MECHANISM BY COLLISIONLESS SHOCK WAVES

R. Kh. Kurtmullaev, Yu. E. Nesterikhin, V. I. Pil'skii, and R. Z. Sagdeev *In its* Plasma Phys. and Controlled Nucl. Fusion Res. 1966 p 250–269 refs (See N67-24161 12-25)

The structures of collisionless shock waves, the processes for the formation and dissipation of their energy as a function of the initial conditions, and the characteristics of the turbulent plasma state at the wave front are presented in connection with a study of plasma heating mechanisms. Theoretical and experimental results obtained reveal that the perturbation observed for rapid compression of the plasma has the form of a traveling shock wave and is not associated with the magnetosonic resonance of the plasma column. The shock wave velocity as a function of all system parameters studies was found to agree with the formula derived. Oscillograms of the magnetic signals for the wave front as a rule are not oscillatory with respect to the unperturbed field that would exist for an oblique wave. It was also concluded that the expansion of the wave front observed after the maximum distortion phase may be interpreted as the tilting effect. Tilting is one of the essential effects associated with cylindrical accumulation. The energy effectiveness of this stage in the growth of the shock wave follows from the fact that radiation bursts, such as neutrons, and radio noise, are always observed at about this time. R.Ll.

N67-24177# Atomic Energy Commission, Oak Ridge, Tenn. Div. of Technical Information Extension.

PHENOMENA ASSOCIATED WITH THE BUILD-UP OF NONCYLINDRICAL FOCUSED Z-PINCH

N. V. Filippov and T. I. Filippova *In its* Plasma Phys. and Controlled Nucl. Fusion Res. 1966 p 270–283 refs (See N67-24161 12-25)

Using the pinch setup with a capacitor battery of 180 μF, studies were conducted on the central region of a deuterium discharge within a large metallic-walled chamber. Emphasis was on noncylindrical build-ups of Z-pinches in such chambers, as well as processes of plasma shell formation, its structure, and its dynamics of motion. The research was conducted because the initial stage of the discharge seemed to strongly influence the plasma focus parameters obtained during the build-up. The basic phase of the discharge—the compression of the shell towards the axis under the influence of the electrodynamic forces—is characterized by the creation of a shock wave and a transition to supersonic motion. Simultaneously with the production of the wave, which plays a stabilizing role during the process of motion, peculiarities appear which are connected with the particular type of compression under study related to the noncylindrical character of the pinch. Reproduced photoscans depict the build-up of the shock wave, convergence of the current layer, a region coinciding in time with the neutron emission, and the metallic electrode vapor luminosity. R.Ll.

N67-24178# Atomic Energy Commission, Oak Ridge, Tenn. Div. of Technical Information Extension.

OSCILLATIONS AND STABILITY OF PLASMA LOCATED IN AN EXTERNAL HIGH-FREQUENCY ELECTRIC FIELD

Yu. M. Aliev, L. M. Gorbunov, V. P. Silin, and H. Watson *In its* Plasma Phys. and Controlled Nucl. Fusion Res. 1966 p 284–298 refs (See N67-24161 12-25)

Certain results are outlined on a hydrodynamical investigation of cold plasma. The external electric field considered is assumed to be spatially uniform, and the wavelength of plasma oscillations under study are small compared with the characteristic dimensions of the inhomogeneity of the external electric field. Attention is focused on the investigation of potential oscillations of plasma in an external high-frequency electric field. In addition to the study of the new unstable plasma connected with parametric resonance, the influence of the external high-frequency electric field on the previously investigated current and beam instability was investigated. R.Ll.

N67-24179# Atomic Energy Commission, Oak Ridge, Tenn. Div. of Technical Information Extension.

NONLINEAR PLASMA WAVE INTERACTION

A. K. Gailitis, L. M. Gorbunov, L. M. Kovrizhnykh, V. V. Pustovalov, V. P. Silin et al *In its* Plasma Phys. and Controlled Nucl. Fusion Res. 1966 p 299–326 refs (See N67-24161 12-25)

Experimental results on the nonlinear interaction of plasma waves in homogeneous, isotropic, completely ionized, and rarefied plasma. By solving the kinetic equation in the self-consistent field approximation, a nonlinear material equation for a plasma was obtained and then used to write the equation for nonlinear electrodynamics. An equation is derived for the evolution of electromagnetic field noises in the plasma when account is taken of the nonlinear interaction between waves. Particular attention is paid to the case of isotropic, homogeneous plasma. The nonlinear interaction of a Langmuir and a transverse wave is considered, and the contribution which this process makes to energy changes in longitudinal and transverse waves discussed. The process of nonlinear interaction of two transverse waves resulting in the formation of another transverse wave is studied. Also investigated is the nonlinear interaction of ionic sound waves resulting both from induced scattering on particles and from fusion and decay with longitudinal and transverse waves, with particular attention to processes involving the participation of four waves. R.Ll.

N67-24180# Atomic Energy Commission, Oak Ridge, Tenn. Div. of Technical Information Extension.

NONLINEAR INTERACTION OF ELECTROMAGNETIC WAVES IN A MAGNETO-ACTIVE PLASMA

A. P. Kropotkin and V. V. Pustovalov *In its* Plasma Phys. and Controlled Nucl. Fusion Res. 1966 p 327–356 refs (See N67-24161 12-25)

For a magneto-active plasma, equations are derived in a theory of induced scattering of electromagnetic waves. The interaction of electromagnetic waves in a magneto-active plasma plays the greatest part as far as nonlinearity is concerned in cases where the spectra of the interacting waves do not satisfy decay conditions. In such a case to obtain the starting equations, terms up to and including those of the third order must be taken into account for the purpose of breaking down the current density by order of field. Particular attention was paid to wave interaction in a cold plasma, and also to the interaction of longitudinal waves in nonisothermic and other plasmas with arbitrary electron and ion temperatures. The equations for nonlinear interaction of magnetic waves in a magneto-active plasma were used to calculate the cross sections for the induced scattering of these waves on the plasma particles. R.Ll.

N67-24181# Atomic Energy Commission, Oak Ridge, Tenn. Div. of Technical Information Extension.

PLASMA-JET DEFLECTION IN A MAGNETIC FIELD

V. D. Demichev, V. D. Matyukhin, A. V. Nikologorskii, and V. M. Strunnikov *In its* Plasma Phys. and Controlled Nucl. Fusion Res. 1966 p 357–377 refs (See N67-24161 12-25)

In an investigation of plasma-jet deflection in a magnetic field, preliminary experiments were conducted on the passage of plasma through the magnetic field created by the rectilinear sections of the conductors. The effectiveness was tested of the chosen field configuration for the transport of dense plasma jets. The configuration of the magnetic field used proved to be sufficiently effective for the rotation of a plasma jet having an initial velocity of $8 \cdot 10^6$ cm/sec and a maximum initial density of $2 \cdot 10^{15}$ cm^{-3}. The plasma passed through the magnetic system close to the axial line. In spite of the fact that the loss of particles was quite significant, during the rotation of the plasma jet, because of the presence of the gap, the magnetic system used produced a plasma jet of significant concentration and an overall number of particles 10^{17} following the turn. As a result of the rotation, a practically complete removal of the neutral gas accompanying the plasma jet was noted, and a fully ionized plasma attained. R.Ll.

N67-24182# Atomic Energy Commission, Oak Ridge, Tenn. Div. of Technical Information Extension.

INTERACTION OF A PLASMA WITH A MAGNETIC FIELD

B. G. Safronov, A. G. Gorbanyuk, I. N. Onishchenko, N. A. Khiznyak, V. S. Voitsenya et al *In its* Plasma Phys. and Controlled Nucl. Fusion Res. 1966 p 378–398 refs (See N67-24161 12-25)

Experimental results are reviewed on the passage and decontamination of fast plasmoids of high density ($n_0 > 10^{13}$ cm^{-3}, $4\pi n_0 Mc^2/H_0^2 \approx 5 \times 10^3 >> 1$). After passing through the rectilinear section of the magnetic field (L=150 cm) plasma entered the toroidal magnetic field (radius of curvature, 75 cm; angle of deflection, approximately 90°). On entry into the toroidal solenoid, the velocity of the plasma fronts of density $n_1 \approx 10^{12}$ cm^{-3} and $n_2 \approx 10^{13}$ cm^{-3} was 7×10^7 cm/sec. By photometric measurement of the Thompson parabolas, the mean energy of the H^+ ions was found to exceed 3 keV, while impurities, chiefly carbon and oxygen ions, accounted for about 40%. The mean energy of the impurity ions passing through the toroidal field was approximately twice the initial energy (after passing through the straight solenoid). R.Ll.

N67-24183# Atomic Energy Commission, Oak Ridge, Tenn. Div. of Technical Information Extension.

PLASMA-COLUMN EQUILIBRIUM IN "TOKAMAK-5"

V. S. Mukhovatov *In its* Plasma Phys. and Controlled Nucl. Fusion Res. 1966 p 399–416 refs (See N67-24161 12-25)

An attempt was made to determine the relative role of the mechanism of constraining the plasma column conditions in the Tokamak-5 apparatus. A schematic illustrates the distribution of currents between diaphragm elements and liner 1 μsec after the beginning of the discharge. An analysis of results obtained from experiments made with closed diaphragm leads to the conclusion that the transverse drift current, completed through the diaphragm need not exhibit a noticeable effect on the equilibrium of the plasma column, if the magnitude of the longitudinal current in the plasma is sufficiently large. However, in the initial and final stages of the discharge, when the longitudinal current is small, the transverse current can play a decisive role in containing the column. The results of the probe measurements showed that the effect of the transverse magnetic field on the equilibrium position of the column is in qualitative agreement with expectations. R.Ll.

N67-24184# Atomic Energy Commission, Oak Ridge, Tenn. Div. of Technical Information Extension.

JOULE HEATING OF PLASMA IN THE TOROIDAL TOKAMAK-3

L. A. Artsimovitch, V. V. Afrosimov, I. P. Glaskovskii, M. P. Petrov, and V. S. Strelkov *In its* Plasma Phys. and Controlled Nucl. Fusion Res. 1966 p 417–439 refs (See N67-24161 12-25)

To study the Joule heating in annular plasma columns stabilized by a strong longitudinal magnetic field, the Tokamak-3 machine was used. An attempt was made to reduce the interaction between the plasma column and the diaphragm. The observed instabilities in the plasma column may be related to a change in the magnetohydrodynamic structure. While the instability occurs, the energy spectrum of ions is enriched with ions of higher energies and becomes very markedly non-Maxwellian. This indicates that, at that moment, accelerating processes occur in the plasma. R.Ll.

N67-24185# Atomic Energy Commission, Oak Ridge, Tenn. Div. of Technical Information Extension.

HIGHER-MODE INSTABILITIES IN A TOKAMAK DEVICE

N. D. Vinogradova and K. A. Razumova *In its* Plasma Phys. and Controlled Nucl. Fusion Res. 1966 p 440–450 refs (See N67-24161 12-25)

A high speed photography method of plasmas was used in an investigation of higher-mode instabilities in a Tokamak toroidal chamber device. The plasma was studied in the immediate vicinity of the diaphragm; scans were made for sections at 180° to the diaphragm. It is clear from the experimental data cited that a plasma in a Tokamak device constitutes a certain geometrically complex magnetohydrodynamic formation which must be rather rigid in order to maintain itself for several milliseconds. The appearance of complex helical structures in plasmas does not cause fluctuations in such integral parameters of the discharge as the derivative of the current and the voltage per turn. The development of higher mode instabilities causes the formation of a stable configuration. Fluctuations of the voltage oscillograms appear only when the radius of the light pattern is equal to that of the diaphragm. R.Li.

N67-24186# Atomic Energy Commission, Oak Ridge, Tenn. Div. of Technical Information Extension.

ELECTRON DENSITY IN TOKAMAK DEVICES BY THE MICROWAVE METHOD

E. P. Gorbunov *In its* Plasma Phys. and Controlled Nucl. Fusion Res. 1966 p 451–470 refs (See N67-24161 12-25)

The microwave interferometer used to measure electron density records changes in phase of a wave passing through the plasma. To determine the value of the electron density in Tokamak devices, it is necessary to know the magnitude of the plasma column at each moment of time and the position of the axis of the plasma column relative to the center of the chamber. The method of probing at several points of the cross section of the plasma column is used to determine these values. In the working range of pressures, the electron density increases linearly with the increase in the initial hydrogen pressure. In working with hydrogen, the maximum electron density remains constant throughout the duration of the discharge. However, the radio interferometer allows determination only of the life of the plasma, not of the average life of the separate particles. The life of the particles is assessed by two methods. One determines the energy life calculated from the results of measuring the energy balance. The other method uses the data of measurements of neutral gas pressure in the jacket surrounding the plasma column. R.Li.

N67-24187# Atomic Energy Commission, Oak Ridge, Tenn. Div. of Technical Information Extension.

PLASMA ENERGY LOSSES IN THE TOROIDAL CHAMBER TOKAMAK TM-2

L. L. Gorelik, K. A. Razumova, and V. V. Sinitsyn *In its* Plasma Phys. and Controlled Nucl. Fusion Res. 1966 p 471–483 refs (See N67-24161 12-25)

Technical details on the distribution of plasma energy losses along the liner surface, together with experimental data on the basic components of these losses and on the energy balance during discharge are summarized. It is shown that if the plasma is macroscopically stable, energy losses to the liner walls in the Tokamak TM-2 toroidal chamber are caused by radiation and neutral particles. These losses are rather uniformly distributed and make up 20 to 90% of the total losses. The remaining energy is lost by being carried to the diaphragm by charged particles. Because of the radiation of impurities dislodged from the diaphragm, the energy losses per unit liner surface are several times greater near the diaphragm than at points some distance from it. These additional energy losses however are localized within a small region around the diaphragm and account for not more than 10% of the total losses. R.Li.

N67-24188# Atomic Energy Commission, Oak Ridge, Tenn. Div. of Technical Information Extension.

TOROIDAL DISCHARGE IN AN ALTERNATING LONGITUDINAL MAGNETIC FIELD

D. N. Ivanov and D. S. Parfenov *In its* Plasma Phys. and Controlled Nucl. Fusion Res. 1966 p 484–498 refs (See N67-24161 12-25)

Summary data are presented on experimental results of a toroidal discharge with a longitudinal magnetic field. It was concluded that a relatively slow drop in plasma density in a stable mode for large longitudinal magnetic field is due to balance between particle inflow and outflow. The increasing longitudinal magnetic field causes a noticeable slowing down in the exit of the particles. The small confinement time is indicative of the small value for the effective transverse conductivity. R.Li.

N67-24189# Atomic Energy Commission, Oak Ridge, Tenn. Div. of Technical Information Extension.

FAST PARTICLES TRAPPED IN A MAGNETIC FIELD

E. S. Borovik, F. I. Busol, B. V. Vlasov, V. A. Kovalenko, E. I. Skibenko et al *In its* Plasma Phys. and Controlled Nucl. Fusion Res. 1966 p 499–513 refs (See N67-24161 12-25)

Certain essential data about the magnetic system of a particle trap are furnished. The distinguishing feature of the magnetic trap with a strong magnetic field is the successive use of cryogenic techniques in solving the basic technological problems. Also discussed are the calculations performed in connection with the problem of filling the trap with plasma. The plasma is formed through the injection into the trap of fast hydrogen atoms with an energy of 30 keV. For an injection current of 0.3 to 0.5 mA a plasma with a density of about $3 \cdot 10^7$ cm^{-3} and a lifetime after injection cut-off of about 5 mA is obtained. The measured lifetime corresponds approximately to the charge-exchange lifetime. R.Li.

N67-24190# Atomic Energy Commission, Oak Ridge, Tenn. Div. of Technical Information Extension.

INJECTION AND CONFINEMENT OF A PLASMA IN A STELLARATOR WITH A MULTIPOLAR (n+2) HELICAL FIELD

D. K. Akulina, G. M. Batanov, M. S. Berezhetskii, S. E. Grebenshchikov, M. S. Rabinovich et al *In its* Plasma Phys. and Controlled Nucl. Fusion Res. 1966 p 514–528 refs (See N67-24161 12-25)

To study closed magnetic traps in multipolar helical fields, stellarators were used. The plasma was produced in the trap by direct ionization by the passage of a current and subsequent resistive heating. Experiments are described on the external plasma-blob injection and containment of a plasma with the aid of the L-1 stellarator. R.Li.

N67-24191# Atomic Energy Commission, Oak Ridge, Tenn. Div. of Technical Information Extension.

PLASMA HEATING UNDER BEAM INSTABILITY CONDITIONS

R. A. Demirkhanov, A. K. Gervorkv, A. F. Popov, and G. I. Khorasonov *In its* Plasma Phys. and Controlled Nucl. Fusion Res. 1966 p 529–540 refs (See N67-24161 12-25)

To experimentally investigate the possibility of heating by injecting a beam of electrons into plasma, an experimental apparatus with magnetic field of mirror configuration was constructed. Under conditions of beam instability, intense X-ray radiation was observed. Graphic data presents the variation of amplitude of frequency oscillations with the strength of the magnetic field. These oscillations were connected with the possibility of formation of a radial electric field and by the rotation of a nonhomogeneous plasma. The influence of such oscillations on plasma stability in a mirror is not clear at present. A tendency was observed of the increase of density of heated particles and their energies being linked with an increase of the beam current and energy. R.Li.

N67-24192# Atomic Energy Commission, Oak Ridge, Tenn. Div. of Technical Information Extension.

PLASMA COMPRESSION BY A MAGNETIC FIELD IN A TOROIDAL DEVICE

V. E. Golant, M. G. Kaganskii, B. A. Ovsyannikov, and A. D. Piliya *In its* Plasma Phys. and Controlled Nucl. Fusion Res. 1966 p 541–559 (See N67-24161 12-25)

In an investigation of plasma compression, experiments performed in the Tuman toroidal device with a lengthwise inhomogeneous magnetic field have been successful enough to obtain a plasma with a degree of ionization reaching 50 to 90% and temperature of 4 to 8 eV, in the presence of hydrogen pressures of from $2\cdot10^{-2}$ to $2\cdot10^{-3}$ mm Hg. At a hydrogen pressure of $1\cdot10^{-2}$ mm Hg and a magnetic field intensity of 1000 to 2000 Oe (in the toroidal parts of the chamber), a plasma concentration of $5\cdot10^{14}$ cm^{-3} could be obtained. The energetic plasma retention time was 20 μsec. Under these conditions, preliminary experiments with compression of plasma by an increasing magnetic field in the straight sectors of the device were carried out; during compression, the plasma-column diameter was observed to diminish to a fraction of its original size. R.Li.

N67-24193# Atomic Energy Commission, Oak Ridge, Tenn. Div. of Technical Information Extension.

TURBULENT HEATING OF A PLASMA BY A DIRECT CURRENT DISCHARGE

M. V. Babykin, P. P. Gavrin, E. K. Zavoiskii, S. L. Nedoseev, L. I. Rudakov et al *In its* Plasma Phys. and Controlled Nucl. Fusion Res. 1966 p 560–570 refs (See N67-24161 12-25)

The turbulent heating of a plasma by a current flowing along a constant or quasi-stationary magnetic field is considered. During the current discharge, the plasma concentration and the magnetic flux through the loop surrounding the plasma were measured. The decrease in flux was determined by graphical integration of the oscillogram. The plasma pressure after heating depends strongly on the applied voltage. Experimental results furnished can be interpreted on the basis of the nonlinear current instability theory. R.Li.

N67-24194# Atomic Energy Commission, Oak Ridge, Tenn. Div. of Technical Information Extension.

HEATING OF PLASMA ELECTRONS BY UHF FIELDS IN AN ADIABATIC TRAP

V. V. Alikaev, V. M. Glagolev, and S. A. Morozov *In its* Plasma Phys. and Controlled Nucl. Fusion Res. 1966 p 571–595 refs (See N67-24161 12-25)

This paper is devoted to the investigation of the heating of plasma with UHF electromagnetic fields in a region of magnetic fields which correspond to the propagation of slow waves in plasma. Author

N67-24195# Atomic Energy Commission, Oak Ridge, Tenn. Div. of Technical Information Extension.

HEATING OF A DENSE PLASMA IN A METALLIC CHAMBER

N. I. Nazarov, A. I. Ermakov, and V. T. Tolok *In its* Plasma Phys. and Controlled Nuc. Fusion Res. 1966 p 596–605 refs (See N67-24161 12-25)

The authors present results of the experimental investigation of the efficiency of heating plasma by the resonance excitation of electromagnetic waves in the plasma. We used a magnetic trap with a mirror magnetic field. The amplitude of the quasi-constant magnetic field varied smoothly from 0 to 10 kOe. Natural oscillations were set up by resonance excitation in a plasma produced by HF discharge. To excite the natural frequencies of the plasma column, use was made of external spatially periodic currents of 10 MHz flowing through a series of coils with opposed windings. The HF signal imparted to the plasma reaches approximately 100 kV in a pulse $\tau \leq 1$ msec. The investigations show that there is a real possibility of heating the ion component of the plasma to temperatures above 1 keV at a density $n \geq 10^{13}$ cm^{-3} by the resonance excitation of an ion-cyclotron wave of large amplitude. Author

N67-24372# Illinois Univ., Urbana. Dept. of Electrical Engineering.

RESEARCH STUDIES OF HIGH-DENSITY PLASMAS Quarterly Progress Report, 15 Jun.–15 Sep. 1966

E. Bialecke, E. Vesely, T. V. George, L. Dreyer, and T. Dolan Jan. 1967 39 p

(Contract DA-28-043-AMC-00094(E))

(QPR-8; Rept.-8; ECOM-00094-8; AD-646889) CFSTI: HC $3.00/MF $0.65

Experiments to determine the spatial and temporal variations of the electron distribution of the high-density plasma were made using a laser interferometer with increased sensitivity. Spatial and temporal determination of the conductivity of the plasma was continued using this method and is described. Experimental determination of the plasma resistance was made. Also, its variation was noted to changes in hydrogen gas pressure and different capacitor bank voltages. Further experiments were made to determine the effects on the plasma resistance when impurity gases such as neon, krypton and xenon were added to the hydrogen gas. Author (TAB)

N67-24404# Florida Univ., Gainesville. Dept. of Nuclear Engineering Sciences.

NOMOGRAM FOR SAHA'S EQUATION

Richard T. Schneider and Wilhelm G. Wolfer 1966 15 p ref

(Contract Nonr-580-(19))

(AD-647747) CFSTI: HC $3.00/MF $0.65

In the report a nomogram for the solution of Sahas equation is given. This nomogram was developed for the engineer or scientist working in the plasma field who wants a means to find an approximate plasma composition for a given pressure and temperature without too much effort for survey purposes. Nomograms of similar nature have been developed before by Unsold. The nomogram given in this report is designed especially for the determination of the electron density, which is important for applications to plasmas in devices designed for research in direct energy conversion. TAB

N67-24477*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

SINGLE-PHASE INDUCTION ELECTROMAGNETIC PUMP

Richard E. Schwirian Washington, NASA, May 1967 77 p refs

(NASA-TN-D-3950) CFSTI: HC $3.00/MF $0.65 CSCL 20I

Two single-phase induction electromagnetic pumps in which induced electrical currents flow circumferentially in an annulus are analyzed. The analysis assumes a purely radial magnetic field, and differential equations describing the dependence of the magnetic field on the axial coordinate are obtained by using the integrated form of Ampere's law, Maxwell's equations, and Ohm's law. General solutions to these equations are applied to specific configurations by assigning boundary conditions at the annulus inlet and outlet. Performance of single-phase induction pumps is dependent on flow and frequency magnetic Reynolds numbers. Dimensionless functions of these magnetic Reynolds numbers are developed from which pressure, efficiency, core magnetic field strength, and current-voltage requirements can be calculated. Calculations of efficiency and dimensionless developed pressure are also made. For the cases of low flow magnetic Reynolds number with low frequency magnetic Reynolds number and high flow magnetic Reynolds number with low frequency magnetic Reynolds number, simple expressions for ideal efficiency can be obtained.

These single-phase induction pump designs are compared with traveling-field induction pumps of similar geometry. The efficiency differences between the pumps are negligible, but single-phase pumps are more reliable at high temperatures. Author

N67-24494# Pennsylvania State Univ., University Park. Ionospheric Research Lab.
THEORY OF NON-LINEAR MIXED FREQUENCY GENERATION IN AN ANISOTROPIC PLASMA
Keith M. Hagenbuch 10 Jan. 1967 75 p refs
(Contract AF 19(628)-4014; Grant NSF GP-5611)
(AFCRL-67-0087; SR-287; AD-647683) CFSTI: HC $3.00/MF $0.65

The Maxwell equations and the fluid equations for a plasma are expanded in a perturbation series to investigate non-linear mixed frequency generation in a gyromagnetic medium. Neutral particles and ions are assumed to be fixed, collisions are neglected, and the Debye length is assumed to be small compared with the wavelengths of propagating radio waves. Using Fourier transforms the second order amplitudes are found and the mixed frequency energy per unit area generated by two monochromatic waves in a homogeneous slab of thickness Delta-z during the time interval Delta-t are calculated. This result is applied to the case when the interacting waves are not monochromatic and when the plasma is slightly inhomogeneous. Author (TAB)

N67-24661# United Kingdom Atomic Energy Authority, Culham (England).
ADIABATIC INVARIANT AND THE EQUILIBRIUM OF MAGNETICALLY TRAPPED PARTICLES. I: MATHEMATICAL DETAILS
R. J. Hastie, J. B. Taylor, and F. A. Haas Aug. 1966 67 p
(CLM-R-63) BIS: $1.80; HMSO: 9s

The conditions for plasma equilibrium in an arbitrary magnetic field and their relation to the lowest order particle adiabatic invariants, and the form of the higher order contributions to these adiabatic invariants are discussed. The equilibrium conditions are investigated in a systematic way: as the time scale of equilibrium is increased the constraints on the distribution function become more severe until they culminate in the requirement that it be a function of the lowest-order adiabatic invariants. It is shown that this discussion of equilibrium leads to a convenient and novel way of generating the adiabatic invariants, not just to lowest order but including higher order contributions, for which a recurrence formula is derived. When the first correction to the longitudinal invariant $J=\oint v_{\parallel} ds$ is computed some interesting differences are found between the case of particles oscillating between mirrors and that of particles circulating round closed field lines. The effect of electric fields and the extension of the calculations to time dependent magnetic fields, leading to the third adiabatic invariant (the flux invariant) are discussed. Author (NSA)

N67-24836# Aerospace Research Labs., Wright-Patterson AFB, Ohio. Thermo-Mechanics Research Lab.
SURVEY OF INVESTIGATIONS OF ELECTRIC ARC INTERACTIONS WITH MAGNETIC AND AERODYNAMIC FIELDS
Tom W. Myers and Ward C. Roman Sep. 1966 126 p refs
(ARL-66-0184; AD-646752) CFSTI: HC $3.00/MF $0.65

The report summarizes and evaluates the existing literature related to the interaction of an electric arc at pressure levels of one atmosphere or greater with magnetic fields and/or aerodynamic fields which are transverse to the arc column. The scope of this survey does not include the subject of retrograde motion. For the purposes of this survey, the subject is broken up according to whether or not there is net arc motion with respect to the electrodes. When motion occurs, the arc is designated a travelling arc; this is the type of arc which occurs in rail accelerators, arc heaters utilizing magnetically rotated arcs and electric switchgear circuit breakers. When the arc undergoes no net motion with respect to the electrodes it is designated a stationary arc; this type occurs when the arc is balanced in a transverse gas flow by an appropriate transverse magnetic field. The report summarizes the results of the various investigations and presents them graphically for easy comparison. General conclusions which may be drawn from the investigations are presented. Author (TAB)

N67-24855# Princeton Univ., N. J.
ELECTRON-HEAVY PARTICLE NONEQUILIBRIUM IN A DENSE ARGON PLASMA Scientific Interim Report, Oct. 1964–Sep. 1965
Paul F. Jacobs and Jerry Grey Jul. 1966 192 p refs
(Contract AF 33(657)-9962; NSF GP-579)
(Rept.-763; ARL-66-0143; AD-646891) CFSTI: HC $3.00/MF $0.65

A theoretical and experimental study of the degree of electron heavy particle thermal nonequilibrium was conducted for a subsonic argon arcjet plasma at one atmosphere. A criterion for electron-temperature freezing was calculated, and indicated that although electron and heavy-particle temperatures were quite close to each other under typical arcjet environments, measurable departures should be observed at the lower temperature or density conditions. These analytical findings were verified quantitatively by simultaneous experimental measurements of the local electron temperature and heavy-particle temperature in the arcjet. These measurements were made with a unique water-cooled calorimetric-electrostatic probe. Proper interpretations of the electrostatic probe data in a dense plasma (argon at 1 atm) was verified by three accurate independent measurements (calorimetric, log current vs voltage, and saturation current ratio). It was also concluded that under certain (typical) conditions, the cooled electrostatic probe could provide a good approximation to the electron density in a dense plasma, and could provide an indication of plasma flow turbulence. Author (TAB)

N67-24877# Republic Aviation Div., Fairchild Hiller Corp., Farmingdale, N. Y.
GRAVITATIONAL INSTABILITIES OF A DISSIPATIVE FLUID WITH A HORIZONTAL BOUNDARY IN THE PRESENCE OF A MAGNETIC FIELD, VOLUME I Final Report
Leon N. Zadoff and Martin Begun 11 Nov. 1966 43 p refs
(Contract Nonr-4534(00))
(FHR-2242-4, Vol. I; PCD-TR-66-15A; AD-647403) CFSTI: HC $3.00/MF $0.65

The linearized equations describing two fluids, acted on by gravity, with a horizontal boundary between them, are derived. The description includes finite viscosity, electrical resistivity, and the presence of a magnetic field. The dispersion relation, which yields the growth rate of small boundary disturbance versus wavelength, is then obtained. In the limit of zero viscosity and zero conductivity this reduces to the Rayleigh-Taylor instability. Next the density conductivity, and viscosity of the lower fluid are permitted to vanish in the limit, under specified conditions. The result is a dispersion relation involving only the upper fluid parameters. It is found that for specified limiting values of these parameters, familiar, previously obtained forms result. The general dispersion relation permits examination of the effects of viscosity and electrical resistivity by the procedure of finding the roots of an explicit algebraic equation. With this technique, the effect of resistivity on the Rayleigh-Taylor modes and the effect of viscosity on the resistive modes are found. Author (TAB)

N67-24919# Paris Univ., Orsay (France). Lab. de Physique des Plasmas.
THERMAL DISTRIBUTION AND CONDUCTIVITY OF ELECTRONS IN ARGON AND ARGON MOLECULAR GAS MIXTURES

A. Constantin, J. J. Hamm, A. M. Pointu, and R. Rioux [1963] 47 p refs
(Contract AF 61(052)-727)
(AFCRL-66-842; AD-647895) CFSTI: HC$3.00/MF$0.65

Different parameters (as drift velocity in a D.C. electric field, or ratio of odd harmonics in an A.C. electric field) of a weakly ionized gas (argon) are computed in two cases using respectively the Maxwell function and the Margenau function as the electric energy distribution function. A discussion is given about the conditions of validity of such computations and the relative importance of the different collision processes especially between e-e collisions, and elastic e-atom collisions (effects of H2-impurities are taken into account). Author (TAB)

N67-24926# Republic Aviation Div., Fairchild Hiller Corp., Farmingdale, N. Y.
PHOTOGRAPHIC STUDIES OF A Z PINCH FOR PLASMA ACCELERATION, VOLUME II Final Report
Martin Begun and Leon N. Zadoff 11 Nov. 1966 68 p refs
(Contract Nonr-4534(00))
(FHR-2242-4, Vol. II; PCD-TR-66-15B, Vol. II; AD-647405) CFSTI: HC$3.00/MF$0.65

A linear pinch apparatus with provisions for photographing the radial and axial view was constructed. The axial view was used to study the dynamics of the pinch, and the radial view to study formation of Rayleigh-Taylor instabilities. The sheath dynamics indicated that a porous piston model is required to explain the experimental data. Rayleigh-Taylor instability theory was used to demonstrate that the sheath was almost completely ionized. Author (TAB)

N67-24935# Innsbruck Univ. (Austria). Inst. for Theoretical Physics.
ON NUMERICAL RESULTS OF A ONE-DIMENSIONAL UNSTEADY VARIATIONAL METHOD IN MGD
Franz Herrnegger 30 Dec. 1966 33 p refs
(Contract AF 61(052)-675)
(AFOSR-67-0677; AD-647885) CFSTI: HC$3.00/MF$0.65

It is shown that the variational principle corresponding to the potential equation for unsteady MGD flows lends itself to a direct numerical evaluation of the variational functional with the aid of the Ritz method, leading thus to the construction of an approximate analytic solution for the velocity potential in the case of certain initial value problems. Author (TAB)

N67-24961# Michigan Univ., Ann Arbor.
RELAXATION TO EQUILIBRIUM OF A DILUTE PLASMA Final Report, Jan. 1, 1967–Dec. 31, 1966
R. S. B. Ong 30 Jan. 1967 8 p refs
(Grant AF-AFOSR-825-65)
(AFOSR-67-0395; AD-647446) CFSTI: HC$3.00/MF$0.65

The Fokker-Planck collision operator of an electron plasma is shown to possess a continuous eigenvalue spectrum extending all the way from zero to infinity. The most interesting consequence of this continuous eigenvalue spectrum is manifested in the fact that the final stage of decay to equilibrium does not proceed exponentially at all, but rather it is an extremely slow process proportional to the inverse power of the time variable. A comparison is made between the decay processes due to the Fokker-Planck operator and the Brownian Motion operator. Except for the long time behaviour the Brownian Motion operator is a reasonable approximation if the time scale factor is reduced by a factor of order five, and only velocities less than a few times the thermal velocity are considered. A classical, frequency dependent electrical conductivity is derived based on the joint solution of the first two equations of the BBGKY hierarchy without using Bogolyubov's adiabatic hypothesis. The analysis yields a generalization of the expression for the high-frequency conductivity as obtained by Oberman, Ron, and Dawson. Author (TAB)

N67-25010* National Aeronautics and Space Administration, Washington, D. C.
PROBLEM OF MULTI-PHOTON FREQUENCY INCREASE WITH ELECTRODIPOLE REACTIONS IN GASES [O MNOGOFOTONNOM UMNOZHENII CHASTOTY PRI ELEKTRODIPOL'NYKH VZAIMODEYSTVIYAKH V GAZAKH]
I. I. Minakova and T. A. Semenova Feb. 1967 5 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. Fiz. Astron. (Moscow), v. 21, no. 5, 1966 p 125–127
(NASA-TT-F-10624) CSCL 20I

Multi-photon frequency increase for electrodipole reactions in gases were used to produce millimeter and sub-millimeter waves. The density matrix method was employed to calculate the transition shift and saturation effects. Author

N67-25022*# National Aeronautics and Space Administration, Washington, D. C.
STUDY OF A NON-ADIABATIC MAGNETIC TRAP [ISSLEDOVANIYE NEADIABATICHESKOY MAGNITNOY LOVUSHKI]
A. P. Slabospitskiy, V. D. Fedorchenko, and B. N. Rutkevich Feb. 1967 7 p refs Transl. into ENGLISH of the book "Fizika Plazmy i Problemy Upravlyayemogo Termoyadernogo Sinteza" Kiev, Izd. Naukova Dumka, 1965 p 388–402
(NASA-TT-F-10752) CFSTI: HC$3.00/MF$0.65 CSCL 20I

In the course of a theoretical study of optimizing the redistribution of charged particle longitudinal energy into the transverse component, a law for the variation of the magnetic field in a magnetic trap was derived. A variable field magnetic trap is described. Up to 70% redistribution was obtained for electrons. Author

N67-25027* National Aeronautics and Space Administration, Washington, D. C.
INTERACTION OF LONGITUDINAL, SURFACE, AND TRANSVERSE WAVES ON A PLASMA BOUNDARY [VZAIMOOTNOSHENIYE PRODOL'NOY, POVERKHNOSTNOY I POPERECHNYKH VOLN NA GRANITSE PLAZMY]
B. Chakrabroti Feb. 1967 11 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. III: Fiz.-Astron. (Moscow), v. 21, no. 5, 1966 p 30–38
(NASA-TT-F-10620) CSCL 20I

It is shown that an incident, transverse wave excites a surface wave, a contraction wave, and a transverse wave in a plasma. General expressions are obtained for amplitude, energy intensity, and phases of all four types of waves, including a reflected wave in a plasma. Author

N67-25032*# National Aeronautics and Space Administration, Washington, D. C.
QUANTUM HYDRODYNAMIC EQUATIONS FOR MULTI-COMPONENT SYSTEMS [K URAVNENIYAM KVANTOVOY GIDRODINAMIKI DLYA MNOGO KOMPONENTNYKH SISTEM]
V. A. Krasnikov Feb. 1967 9 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. III: Fiz.-Astron. (Moscow), v. 21, no. 5, 1966 p 63–69
(NASA-TT-F-10622) CFSTI: HC$3.00/MF$0.65 CSCL 20I

Hydrodynamics equations are derived on the basis of quantum statistics for multi-component systems in an ideal liquid approximation. A system (which interacts by means of central forces) of Fermi and Bose particles is investigated, in which the Hamiltonian is represented in a secondary quantization form. C.T.C.

N67-25076*# Stanford Univ., Calif. Plasma Gasdynamics Lab.
DIAGNOSTICS OF MHD GENERATOR PLASMAS

C. H. Kruger, M. Mitchner, and R. H. Eustis 28 Feb. 1967 80 p refs
(Contract NAS3-6261)
(NASA-CR-54667) CFSTI: HC$3.00/MF$0.65 CSCL 20I

A noble-gas MHD generator was constructed and its performance measured. Wall leakage and Hall effects seriously degraded the generator performance. A spectroscopic interference-filter photographic technique was devised for spatially resolving the electron temperature distribution, and microwave measurements showed nonequilibrium electron concentration after expansion in a supersonic nozzle. The effect of the electric field on the electron distribution function was determined, and procedures for calculating electrical conductivity and Hall parameter were evaluated. Theoretical calculation of current distribution in segmented MHD generators showed important effects of temperature or conductivity gradients. Author

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N67-23500# Norwegian Inst. of Tech., Trondheim. Div. of Physical Electronics.
ELECTROMAGNETIC PROPERTIES OF DRIFTED SEMICONDUCTOR PLASMAS. PART 1: NORMAL MODES IN THE INFINITE MEDIUM
Tore Wessel-Berg Sep. 1966 29 p refs
(Contract AF 61(052)-907)
(TR-1; AD-645779) CFSTI: HC$3.00/MF$0.65

The report deals with bulk phenomena in semiconductor materials with drifting majority carriers. Assuming wave solutions, the permittivity tensor is derived for this type of electromagnetic medium. The general wave equation is solved for the elementary modes which consist of a complete set of TE and TM modes. The TM modes are separated in irrotational carrier waves or space charge waves and solenoidal electromagnetic waves. The appropriate dispersion relations and state vectors are presented for all the elementary modes together with a discussion of their properties. Author (TAB)

N67-23550# California Univ., Berkeley. Lawrence Radiation Lab.
WORK FUNCTIONS OF MONOCRYSTALLINE AND POLYCRYSTALLINE RHENIUM
Ronald Wichner (Ph.D. Thesis) Aug. 1966 108 p refs
(Contract W-7405-ENG-48)
(UCRL-16662) CFSTI: HC$3.00/MF$0.65

The bare work functions of polycrystalline rhenium and of the $(10\bar{1}0)$, $(10\bar{1}1)$, and (0001) orientations have been determined for planar emitters, in vacuum, at pressures of 2×10^{-10} to 7×10^{-9} torr and in the temperature range, 1415 to 2021°C. Electron emission currents were obtained in a thermionic diode as a function of applied voltage, at a number of temperatures. The work functions were determined by means of the Richardson plot and also deduced from the position of the knee in the current–voltage characteristic. The work function, ϕ, and Richardson "A" value, A_r, were found to be as follows: ϕ(poly) = 4.93 ± .02 eV, A_r(poly) = 74 ± 21 A/cm^{2}K^2; $\phi(10\bar{1}0)$ = 5.15 ± .02 eV, $A_r(10\bar{1}0)$ = 76 ± 21 A/cm^{2}K^2; $\phi(10\bar{1}1)$ = 5.37 ± .03 eV, $A_r(10\bar{1}1)$ = 119 ± 40 A/cm^{2}K^2; ϕ(0001) = 5.59 ± .05 eV, A_r(0001) = 199 ± 49 A/cm^{2}K^2. A guarded, single-crystal copper collector was employed in a plane geometry configuration in order to minimize edge and other nonuniform effects. A method was also developed for brazing the emitter buttons to tantalum support cups, using niobium as the high-temperature braze material. Author (NSA)

N67-23586# Iowa State Univ. of Science and Technology, Ames.
LANDAU SPECTRUM AND LINE BROADENING IN REAL METALS
Lloyd Craig Davis (Ph.D. Thesis) Nov. 1966 64 p refs
(Contract W-7405-ENG-82)
(IS-T-111) CFSTI: HC$3.00/MF$0.65

The energy spectrum and level broadening of conduction electrons in the presence of a uniform magnetic field has been studied within the framework of the effective Hamiltonian formalism. A simple model which demonstrates the important ideas involved has been chosen. WKB solutions to the effective Hamiltonian have been found for this model. By using connection formulas which are accurate for all energies, it was shown how the degeneracies among the WKB solutions in different zones in reciprocal space are removed. These connection formulas were expressed in terms of a transmission amplitude p and a reflection amplitude q. It has been found that the Landau levels are given accurately by the Onsager rules and are essentially discrete except in the immediate vicinity of open orbits. The transition between the nearly discrete closed orbit region and the continuous open orbit region was found to occur in an energy range of only a few $\hbar\omega_c$. The eigenvalues and eigenfunctions of the effective Hamiltonian were shown to be consistent with the requirements of a group theoretical treatment of the exact Hamiltonian. Therefore, it has been concluded that no source of level broadening in a perfect crystal (other than interband effects) has been omitted. A justification of Pippard's linear network model for magnetic breakdown has been given within the effective Hamiltonian formalism. The effects of internal strains and dislocations on the energy levels have also been considered. Author (NSA)

N67-23610# Army Electronics Labs., Fort Monmouth, N. J.
INSTABILITIES IN PYROLYTICALLY DEPOSITED SILICON DIOXIDE FILMS AT ROOM TEMPERATURE
William Leighton Nov. 1966 17 p refs
(ECOM-2779; AD-645507) CFSTI: HC$3.00/MF$0.65

The report describes instabilities at room temperatures in metal-oxide semiconductor structures having SiO2 films deposited by decomposition of TEOS. These instabilities are manifested in a shift, along the voltage axis, of the capacitance voltage characteristics after the capacitor has been subjected to a voltage stress in the reverse direction. Typical shifts amounted to 13 volts (after application of 50 volts bias for thirty minutes) and could not be reversed even by prolonged application of a forward voltage. This effect, which is similar to that occurring at higher temperatures in MOS diodes having thermal oxide interfaces, is usually attributed to ion migration through the oxide. If a similar explanation holds true for the present observation, much higher ion mobilities at room temperatures must be assumed for TEOS oxides. However, the irreversibility of the effect also suggests that surface effects might be involved in the mechanism. Author (TAB)

N67-23785# Naval Ordnance Lab., Corona, Calif.
SEMICONDUCTOR PHYSICS. TWO-PHONON MATRIX ELEMENTS AND ABSORPTION FOR CRYSTAL MODELS WITH ZINC BLENDE STRUCTURE
A. Nedoluha *In its* Foundational Res. Proj. 1 Dec. 1966 p 35-54 refs (See N67-23781 12-23)

Calculations are presented on the summation bands in a crystal of rigid particles with nearest neighbor interaction through central second and third order potentials. A simple crystal model of rigid ions with central nearest neighbor interactions is used; it is assumed that the absorption process is caused by a cubic perturbation in the potential. Equations are derived for the eigenfrequencies and matrix elements at arbitrary wave vectors in closed form. Expansions are obtained for the contributions of the vicinities of the critical points to the densities of states and to absorption. Using a root sampling method, computer calculations were made to supplement the analytical calculations. The number

of points sampled in 1/48 of the Brillouin zone corresponds to a total of 4 million points in the full zone. In smoothing the raw data, the known singular behavior in the vicinity of the critical points was used. The resulting graphs are included. M.G.J.

N67-23787# Naval Ordnance Lab., Corona, Calif.
A NEW DEVELOPMENT IN IONIC CRYSTAL THEORY
E. H. Hygh and J. D. Merriam *In its* Foundational Res. Proj. 1 Dec. 1966 p 87–97 refs (See N67-23781 12-23)

A model is advanced for KCl crystals in which the K^+ sublattice and the Cl^- sublattice are treated separately by means of a quantum mechanical approach. The KCl crystal binding is developed by using a classical interaction between the sublattices, and a formalism is developed for describing the physical properties of the crystal which is amenable to problems involving impurities in the crystal. Author

N67-23839# Royal Inst. of Tech., Stockholm (Sweden). Microwave Dept.
A HIGH FREQUENCY SEMICONDUCTOR INSTABILITY DUE TO AMBIPOLAR DIFFUSION
K. Bloetekjaer and P. Weissglas 8 Nov. 1966 10 p ref
(Contract AF 61(052)-895)
(SR-11; RADC-TR-67-34; AD-645746) CFSTI: HC $3.00/MF $0.65

A new high frequency semiconductor instability is proposed. The instability arises when a sufficiently strong d. c. electron field is applied to a semiconductor which has a high conductivity and contain both electrons and holes. The d. c. field must elevate the effective electron temperature to about three times the background lattice temperature. The instability is caused by the temperature dependence of the ambipolar diffusion coefficient. Author (TAB)

N67-23841# University of Southern Calif., Los Angeles. Electronic Sciences Lab.
[SOLID STATE, APPLIED ELECTROMAGNETICS AND PLASMAS, AND INFORMATION SCIENCES] Consolidated Semiannual Progress Report No. 4, 1 Apr.–30 Sep. 1966
30 Sep. 1966 211 p refs
(Grants NGR-05-018-022; NGR-05-019-044; NGR-05-018-052; AF-AFOSR-76-66; AF-AFOSR-188-66 et al)
(AD-802270) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. SEMICONDUCTORS D. B. Wittry et al p 1–59 refs (See N67-23842 12-26)
2. QUANTUM ELECTRONICS W. H. Louisell p 60–77 refs (See N67-23843 12-26)
3. MAGNETISM T. Hartwick et al p 79–92 ref (See N67-23844 12-26)
4. CRYSTALS F. A. Kroger et al p 93–101 (See N67-23845 12-26)
5. SUPERCONDUCTIVITY M. A. R. LeBlanc, D. J. Griffiths, B. C. Belanger, C. T. M. Chang, H. G. Mattes et al p 102–111 (See N67-23846 12-26)
6. PLASMAS H. H. Kuehl and G. E. Stewart p 112–123 refs (See N67-23847 12-25)
7. RADIATION AND DIFFRACTION OF ELECTROMAGNETIC WAVES C. Yeh p 124–129 ref (See N67-23848 12-25)
8. CONTROL SYSTEMS L. Neustadt p 129–154 ref (See N67-23849 12-10)
9. INFORMATION PROCESSING AND SIGNAL DESIGN THEORY R. A. Scholtz and C. L. Weber p 154–168 refs (See N67-23850 12-07)
10. CODING THEORY AND AUTOMATA STUDIES S. W. Golomb p 169–173 refs (See N67-23851 12-07)
11. HYBRID AND DIGITAL COMPUTATION R. B. McGhee and R. B. Walford p 174–177 refs (See N67-23852 12-08)
12. BIOLOGICAL ENGINEERING W. Morrison and G. A. Bekey p 178–183 (See N67-23853 12-05)

N67-23842# University of Southern Calif., Los Angeles. Electronic Sciences Lab.
SEMICONDUCTORS
D. B. Wittry et al *In its* [Solid State, Appl. Electromagnetics and Plasmas, and Inform. Sci.] 30 Sep. 1966 p 1–59 refs (See N67-23841 12-26)

The following topics are discussed: (1) *Electron Probe Analysis of Semiconductors*—cathode luminescence measurements in the gallium arsenide phosphorus system and the influence of strain and heat; (2) *Electron Transport and X-ray Production in Solids*—computer program for energy distribution, position, and angle of electrons impinging on specimen; (3) *Local Mode Absorption in Heavily Doped Lithium Compensated Gallium Arsenide*—absorption effects of tellurium, manganese, cadmium, zinc, and silicon impurities; (4) *Local Mode Absorption in Compensated Silicon-Doped Gallium Arsenide*—lithium and silicon infrared modes in compensated silicon-doped gallium arsenide samples; (5) *Lithium-Defect Complexes in Gallium Arsenide*—bendover effect in boron-doped silicon samples; (6) *Thin Film and Interface Phenomena*—charge transport phenomena near metal-semiconductor, metal-insulator, and p–n junctions; and (7) *Preparation and properties of Gallium–Indium Arsenide*—growth of GaAs, and development of optical apparatus to measure absorption edge, photo-conductivity, and photoluminescence. G.G.

N67-23843# University of Southern Calif., Los Angeles.
QUANTUM ELECTRONICS
W. H. Louisell *In its* [Solid State, Appl. Electromagnetics and Plasmas, and Inform. Sci.] 30 Sep. 1966 p 60–77 refs (See N67-23841 12-26)
(Grant AF-AFOSR-496-66)

A dynamic correspondence was set up between the density operator of an electromagnetic field and an associated classical function for a laser in which all atomic decay rates were faster than photon rates. The resulting associated classical function satisfied a Fokker–Planck type equation and was reduced to a rotating-wave van der Pol oscillator. Quantum electronic techniques were also applied to investigate ionic cross-relaxation effects in neodymium–glass oscillators by injecting light into the laser medium. The diagram for a narrowband radiation source located in the laser feedback path of the broadband laser was used to obtain a typical 100 Å band emission for a pumped neodymium–glass laser with neodymium yttrium garnet as narrowband source. G.G.

N67-23844# University of Southern Calif., Los Angeles.
MAGNETISM
T. Hartwick et al *In its* [Solid State, Appl. Electromagnetics and Plasmas, and Inform. Sci.] 30 Sep. 1966 p 79–92 ref (See N67-23841 12-26)
(Grant AF-AFOSR-496-66)

Reported are the following magnetic studies: (1) *Ferromagnetic Resonance in Doped YIG Crystals*—analysis of magnetic annealing effects in Si doped YIG that arise from electron diffusion to Fe^{+3} ions, and the temperature effect on the resonance field; (2) *Nuclear Magnetic Resonance of Nickel–Copper Alloy*—temperature dependence of nickel and copper resonances; (3) *Study of Europium Sulfur–Yttrium Sulfur, and Europium Selenium–Yttrium Selenium Compounds*—contributions of conduction electrons to magnetic interactions; and (4) *Moessbauer Effect Experiment on Iron Beryllium Compounds*—gamma ray resonance absorption in relation to the iron nucleus content. G.G.

N67-23845# University of Southern Calif., Los Angeles.
CRYSTALS

F. A. Kroger et al *In its* [Solid State, Appl. Electromagnetics and Plasmas, and Inform. Sci.] 30 Sep. 1966 p 93–101 (See N67-23841 12-26)
(Grant AF-AFOSR-496-66)

Discussed are: (1) *Defect Chemistry of Cadmium Sulfide*—high temperature cadmium vapor measurements on Hall effect and resistivity of CdS crystals in equilibrium; (2) *Optical Properties of Bromine-Rich Silver Bromide*—optical absorption strength increased with bromine vapor pressure at high temperature; (3) *Ionic Conductivity in High-Resistivity Cadmium Sulfide*—doping with donors and equilibrating under sulfur pressure increased ratio of cadmium vacancies to electrons; (4) *The Conduction Mechanism of Ammonium Chloride*—projected emf measurements and electrolysis experiments; and (5) *Diffusion in a Concentration Gradient*—diffusion mechanisms and development of dislocations. G.G.

N67-23846# University of Southern Calif., Los Angeles.
SUPERCONDUCTIVITY
M. A. R. LeBlanc, D. J. Griffiths, B. C. Belanger, C. T. M. Chang, H. G. Mattes et al *In its* [Solid State, Appl. Electromagnetics and Plasma, and Inform. Sci.] 30 Sep. 1966 p 102–111 (See N67-23841 12-26)

Type II superconductors displayed markedly different hysteretic behavior, depending on the magnetic field present, with a tendency to either flux expulsion or flux retention in low decreasing fields. The type of behavior was determined by whether the sample cooled through T_c to T_f in a field $H > H_{cl}$ regardless of subsequent field cycles. It was concluded that the configuration of quantum numbers at low decreasing fields depended on the configuration established during cooling and that the memory of these instructions was preserved during passage through low fields. Optimum configurations were achieved in intermediate fields when the conduction current generated the axial field configuration most suitable. G.G.

N67-23899# Iowa State Univ. of Science and Technology, Ames.
A MOESSBAUER EFFECT STUDY OF THE CRYSTAL FIELD POTENTIAL IN INTERMETALLIC COMPOUNDS OF THULIUM
Dennis Joseph Genin (Ph.D. Thesis) Nov. 1966 114 p refs
(Contract W-7405-ENG-82)
(IS-T-104) CFSTI: HC $3.00/MF $0.65

Crystal field potentials in Tm-intermetallic compounds were investigated by measuring the temperature dependence of the nuclear quadrupole splitting of the 8.42 keV gamma transition in ^{169}Tm. Mössbauer effect investigations were carried out in the temperature range between 4.2 and 300°K. The quadrupole splittings were accurately determined by computer-fitting theoretical lineshapes to the data. Crystal field parameters for the C_{3v} symmetry in $TmRu_2$ and $TmMn_2$ were determined by a best fit to the temperature dependence of the quadrupole interaction. Over-all crystal field splittings were found to be 92 and 69 cm^{-1} in $TmRu_2$ and $TmMn_2$ respectively. In both compounds the conduction electron contribution to the electric field gradient was found to be opposite in sign to the temperature-independent lattice contribution. Large shielding of the 4f-electrons from the crystal field, expressed by the shielding factor σ_2 was noted. Anomalous line broadening at low temperatures was explained on the basis of a range of crystal field potentials at the Tm^{3+} ion sites due to lattice imperfections. Author (NSA)

N67-23900# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
MONOENERGETIC BREMSSTRAHLUNG WITH LINEAR POLARIZATION CLOSE TO 100 PERCENT FROM THIN CRYSTAL TARGETS
Gerhard Lutz Nov. 1966 22 p
(DESY-66/37) CFSTI: HC $3.00/MF $0.65

Mozley and de Wire have pointed out that bremsstrahlung from thin crystals can be monochromatized if one strongly collimates the photon beam. In recent papers it was shown that the linear polarization of uncollimated coherent bremsstrahlung can be raised if the crystal is oriented in such a manner that one gets the main contribution to the spectrum from one single reciprocal lattice point only. Here it is shown that by combining this method of orientation of the crystal with strong collimation one gets not only one dominating monoenergetic spike in the spectrum due to this single reciprocal lattice point, but that, in addition, the polarization of the spike is increased to a very high value. A simple procedure is given for deriving these spectra and their polarization for some "universal" curves for silicon and diamond crystals. An estimate is given of the photon intensity which can be reached by this method. Author (NSA)

N67-23963# Library of Congress, Washington, D. C. Aerospace Technology Div.
RARE-EARTH ELEMENT CHELATES AS ACTIVE LASER MATERIALS
John Kourilo *In its* Foreign Sci. Bull., Vol. 3, No. 1 Jan. 1967 p 10–20 refs (See N67-23961 12-23)

Soviet research studies conducted in 1965 on the rare-earth element chelates and their adducts with organic bases were reviewed from the viewpoint of their pertinence to active laser materials. The impression was gained that effort in the area of the rare-earth element chelate-base lasers was concentrated on the β-diketonates of the aromatic series and their adducts, especially those of europium. This effort contributed to the development of a liquid laser system using europium tetrakis (-benzoylacetylacetonato) piperidinium as the active material. Research on the rare-earth element β-diketonates of the heterocyclic series, especially on thenoyl trifluoroacetyl acetonates and its adducts, was pursued at an accelerated rate. Author

N67-23988# Atomic Energy Centre, Lahore (Pakistan). Theoretical Physics Div.
QUANTUM STATISTICAL MECHANICS OF ANISOTROPIC HEISENBERG SPIN SYSTEMS: I—THE FERROMAGNETIC CASE
Raza A. Tahir-Kheli Jun. 1966 91 p refs Submitted for publication
(PAECL/TP-8) CFSTI: HC $3.00/MF $0.65

Expressions for the dynamical spin correlations of an anisotropic Heisenberg farromagnet are obtained by a Green function formalism. A consistent scheme of higher order random phase approximations is developed and the second order RPA is worked out in detail. The spectral functions of the spin correlations are obtained in the form of non linear integral equations, which can only be solved numerically. It turns out that the solution for the longitudinal spectral function can be obtained analytically in an approximate scheme, to be called the modified RPA. The mod. RPA results for the longitudinal correlation function are analyzed in detail for temperatures near and beyond the Curie point and the critical fluctuations, the spin diffusion, the Curie temperature and the critical energy are discussed. Author

N67-23994# Industrial Science and Technology Agency, Tokyo (Japan). Electrotechnical Lab.
ORGANIC SEMICONDUCTORS
Hiroyuki Anzai, Uichi Itoh, Michio Takakusa, and Tatsuji Nakajima Jan. 1966 166 p refs In JAPANESE; ENGLISH summary *Its* Circulars No. 157
CFSTI: HC $3.00/MF $0.65

This handbook contains detailed information on the electric properties of organic semiconductors. Included are a history of organic semiconductor research, tables of electrical data and physical properties, mechanisms of electronic conduction, purification of materials and detection of impurities, preparation of specimens, and

several measurements on conduction and photoconduction including drift and Hall mobilities, pressure effects, external and internal photoelectric effects, and effects of gases and contaminants. R.N.A.

N67-23995# Industrial Science and Technology Agency, Tokyo (Japan). Electrotechnical Lab.
MAGNETORESISTIVE ELEMENTS AND THEIR APPLICATIONS
Shoei Kataoka Dec. 1965 142 p refs In JAPANESE; ENGLISH summary *Its* Researches No. 661
CFSTI: HC $3.00/MF $0.65

The magnetoresistance effect in high mobility intermetallic semiconductors, the fundamental characteristics and the multiplying action of a two-terminal magnetoresistive element, and the theoretical and experimental investigations into the applications of this effect to various kinds of instrumentations are described. The magnetoresistance effect applications to the measurement of dc and ac electric power and microwave power, to the signal transducer from dc to ac, to the wave form analyzer, to the measurement of the absolute value of a magnetic field, to the generation of various kinds of cubic algebraic equations using the square characteristic of the magnetoresistance effect and the linear one of the Hall effect in the same element simultaneously, and to a nonlinear element are discussed. The magnetoresistance effect is compared with the Hall effect whenever possible. The magnetoresistance effect is shown to be quite interesting and useful from an electronics viewpoint, and magnetoresistance elements based on this effect have several advantages over the Hall effect element, such as two terminal device, high sensitivity, and simple construction. R.N.A.

N67-24020# Radio Corp. of America, Princeton, N. J.
INVESTIGATION OF TWO-CARRIER INJECTION ELECTROLUMINESCENCE Final Report, 15 Sep. 1963–14 Sep. 1966
Albert G. Fischer and William H. Fonger 14 Dec. 1966 47 p refs
(Contract AF 19(628)-3866)
(AFCRL-67-0005; AD-647087) CFSTI: HC $3.00/MF $0.65

The following advances were made toward a practical II-VI solid-state light source: Preparation procedures of starting material and growth techniques for II-VI crystals and epitaxial films from melt, solution and vapor, were improved. Highly p-type ZnSe films were prepared. The melting point–composition diagrams of ZnTe and ZnSe were established and the first n-type ZnTe crystals prepared. New types of electroluminescent junctions were found such as the physical inversion layer and the ZnSe-ZnTe quasihomo-junction. The luminescence due to rare-earth ions in ZnSe and ZnSexTe (1-x) crystals was studied. The change of luminescence in ZnSxSe (1-x) mixed crystals was explained in a theory that is generally applicable to the luminescence of mixed crystals. A partial understanding of the phenomenon of self-compensation was gained and new approaches to fight it were devised. The general concept of II-VI electroluminescence was clarified and the problems defined. Author (TAB)

N67-24058# Republic Aviation Corp., Farmingdale, N. Y.
DISLOCATION BARRIER INTERACTIONS IN CUBIC CRYSTALS. VOLUME 1: THE INTERACTION OF DISLOCATIONS IN ANISOTROPIC FACE-CENTERED CUBIC CRYSTALS. STUDY OF THE THEORY OF FRACTURE PHENOMENA Technical Report, 12 Sep. 1963–3 Jan. 1966
L. J. Teutonico Jan. 1967 56 p refs
(Contract AF 29(601)-6241)
(RAC-1699-1; AFWL-TR-66-27, Vol. I; AD-645101) CFSTI: HC $3.00/MF $0.65

An elastic analysis of dislocations in anisotropic media has been applied to study the interaction of dislocations on intersecting (111) planes in the face-centered cubic structure. Both long-range and short-range interactions have been considered in a series of fcc elements; the stability of each configuration resulting from a short-range attraction has been determined. The widths of the possible barriers in the various fcc elements have been computed, and the relative strength and importance of each barrier discussed. The most important barriers are those associated with the long-range interaction of two dislocations whose Burgers vectors are orthogonal. The Lomer-Cottrell barrier, although relatively weak, does exist in the extended form. Author (TAB)

N67-24142 Polish Academy of Sciences, Warsaw. Institute of Basic Technical Problems.
AMPLIFICATION OF ULTRA AND HYPERSONIC SURFACE WAVES IN DIELECTRICS BY MEANS OF CURRENT FLOWING IN A THIN PIEZO-SEMICONDUCTOR BOUNDARY LAYER
S. Kaliski *In its* Proc. of Vibration Probl., Vol. 7, No. 4 1966 p 277–285 refs (See N67-24141 12-23)

A method is proposed for amplifying ultra and hypersonic surface waves in any elastic dielectric showing neither piezoelectric nor semiconducting properties. By generating a surface wave in an elastic dielectric covered by a thin piezo-semiconducting layer, and passing a current through the piezo-semiconducting layer, an amplification effect of the surface wave is obtained for definite critical values of the current parameters. The thickness of the covering layer is considered to be small as compared with the length of the surface wave. Mechanical damping is rejected and linear theory is used. Extrinsic semiconducting materials of the n-type are applied. A simplified scheme of the mechanical action of the layer is assumed. Field effects in the elastic dielectric and vacuum are disregarded. The fundamental equations to the problem are stated, the solution procedure using the dispersion equation is given, the amplification coefficient is found, and a numerical example is presented. R.N.A.

N67-24149# Polish Academy of Sciences, Warsaw. Institute of Basic Technical Problems.
TRAVELING SURFACE WAVES IN FINITE SYSTEMS
S. Kaliski *In its* Proc. of Vibration Probl., Vol. 7, No. 4 1966 p 387–402 refs (See N67-24141 12-23)

An attempt is made to determine whether the existence of a travelling surface wave is possible, under definite conditions, in a finite system for which the influence of the boundary conditions at the ends must be taken into account. It is shown that in the case of surface perturbations cooperating with another travelling system giving self-excitation effects, the occurrence of travelling waves in a finite system is possible. The existence of such waves is demonstrated by two examples. The first concerns the motion of a system of mechanical oscillators over the surface of a sector of an elastic semi-space. The other concerns the flow of a perfect gas over a thin plate resting on the surface of a sector of the semi-space. A few remarks are made concerning the possible occurrence of travelling surface waves in other bounded finite physical systems. R.N.A.

N67-24150 Polish Academy of Sciences, Warsaw. Institute of Basic Technical Problems.
SURFACE WAVES IN PIEZOQUARTZ
S. Kaliski, J. Kapelewski, and Z. Makowski *In its* Proc. of Vibration Probl., Vol. 7, No. 4 1966 p 403–419 refs (See N67-24141 12-23)

Two variants of surface wave propagation are considered. The first is in the plane x_1, x_2, while the other is in the plane x_1, x_3 with the wave moving in the direction x_1. The fundamental equations used are given, the two variants are discussed, and a perturbation solution is obtained for an elastically isotropic crystal. The computations performed for the surface waves in quartz fill

the gap in the existing solution and enable a comparison to be made with experimental values of the velocity of surface waves and the wave decrements to be computed. By applying the perturbation method, closed form solutions can be obtained which are essential for problems of ultra and hypersonic amplifiers using surface waves. R.N.A.

N67-24154# Los Alamos Scientific Lab., N. Mex.
SUPPLEMENT TO TABLES FOR THE RAPID EVALUATION OF THE DEBYE CHARACTERISTIC TEMPERATURE OF CUBIC CRYSTALS FROM ELASTIC CONSTANTS
W. C. Overton, Jr. and A. F. Schuch 20 Jan. 1967 27 p refs
(Contract W-7405-ENG-36)
(LA-3615-MS. Suppl.) CFSTI: HC $3.00/MF $0.65

The main report which this work supplements is entitled "Tables for the Rapid Evaluation of the Debye Characteristic Temperature of Cubic Crystals from Elastic Constants." The range of parameters (s,τ) are extended here such that: $4.53 \leq s \leq 6.01$, $1.00 \leq \tau \leq 4.80$ and $6.03 \leq s \leq 7.51$, $1.00 \leq \tau \leq 4.80$. NSA

N67-24362# Cornell Univ., Ithaca, N. Y. Lab. of Atomic and Solid State Physics.
ON THE BULK (H_{c2}) AND SURFACE (H_{c3}) NUCLEATION FIELDS OF STRONG COUPLING SUPERCONDUCTING ALLOYS
G. Eilenberger and V. Ambegaokar Jan. 1967 33 p refs
(Contract Nonr-401(38))
(TR-17; AD-646909) CFSTI: HC $3.00/MF $0.65

The linearized self consistency equation, in the electron phonon model, for the nucleation of superconductivity in the presence of a magnetic field was studied. It was found that near the transition temperature this integrodifferential equation is susceptible to analysis. The main results were that the ratio of surface to bulk nucleation fields was predicted to have the weak coupling value of 1.695, thus not confirming a recent experimental suggestion of a value near 1.9 for strong coupling superconductors. The slope (differential H sub c3/differential T) sub T sub c was worked out both in terms of integrals over the parameters of the bulk strong coupling theory and in terms of other experimental quantities. Comparison of this last result with existing experiments on pure lead was attempted, with good success. An implicit equation for H sub c2(T) for all T was derived, but the numerical work necessary to solve this equation was not undertaken. Author (TAB)

N67-24374# Douglas Aircraft Co., Inc., Huntington Beach, Calif. Advanced Research Labs.
ORIENTAL ORDER IN FCC SOLID ORTHO-H_2 GREEN FUNCTION TREATMENT OF THE INTERNAL FIELD APPROXIMATION
John C. Raich (Colo. State Univ.), and Richard D. Etters Dec. 1966 22 p refs *Its* Res. Commun. No. 18
(Douglas Paper-4246; AD-644990) CFSTI: HC $3.00/MF $0.65

The technique of temperature-dependent Green functions is applied to a molecular field model of the orientational order-disorder transition of ortho-H2 molecules on an fcc lattice. The chain of equations for the various Green functions is decoupled by an approximation similar to the one used by Tahir-Kheli and ter Haar, which enables one to solve the three remaining Green function equations of motion. It is shown that the Green function approach leads to the same results as the more conventional methods. Author (TAB)

N67-24377# Westinghouse Electric Corp., Pittsburgh, Pa. Research Labs.
DEVELOPMENT OF INJECTION ELECTROLUMINESCENT MATERIALS
Robert C. Miller, Willi Lehmann, Charles S. Duncan, James P. McHugh, and Sylvan Z. Beer Oct. 1966 26 p refs
(Contract Nobs-94326)
(QPR-2; AD-647745) CFSTI: HC $3.00/MF $0.65

The report contains summaries of the work performed on the II-VI compounds and the attempts to prepare luminescent thin films of AlP on tungsten substrates. The work on the II-VIs has been dropped completely and the thin film work postponed until more data is available on the properties of bulk AlP. The effort to obtain thick layers of AlP on silicon substrates has been continued; only thin films have been prepared thus far. The major part of the effort will now be directed toward the determination of the solubility of AlP in a number of solvents so as to permit the solution growth of large crystals. Author (TAB)

N67-24407# Army Electronics Labs., Fort Monmouth, N. J.
INVESTIGATION OF SILVER IODINE FOR POSSIBLE FREQUENCY CONTROL APPLICATIONS
Frank K. Priebe and Arthur D. Ballato Dec. 1966 24 p refs
(ECOM-2784; AD-647774) CFSTI: HC $3.00/MF $0.65

Pellets of silver iodide (AgI) prepared by compression of the powdered substance were investigated by various means to determine if any of the phenomena involved have possible application for the purposes of frequency control. The results of the investigation show that in the VLF range and above no such potential uses are immediately apparent from the experiments conducted. Below these frequencies AgI devices are potentially applicable to seismic and other quasistatic phenomena. Author (TAB)

N67-24491# ManLabs, Inc., Cambridge, Mass.
PHYSICAL EVALUATION OF THIN FILMS OF SOLID STATE MATERIALS Final Report, 1 Dec. 1965–30 Nov. 1966
Edward T. Peters Jan. 1967 37 p refs
(Contract AF 19(628)-5749)
(AFCRL-67-0081; AD-647600) CFSTI: HC $3.00/MF $0.65

Experimental methods include reflection electron diffraction, X-ray diffraction and fluorescent analysis, electron probe microanalysis and light microscopy in addition to the determination of specific properties, such as density, hardness and index of refraction. The materials submitted for analysis include electrodeposits of copper on single crystal copper substrates, vapor deposits of boron phosphide and silicon carbide on selected substrate hosts, high perfection germanium, synthetic and natural spinels and crystals of lithium germanate, calcium tartrate and cuprous chloride. In addition, special services such as crystal orientation and cutting have been performed. Author (TAB)

N67-24574# Argonne National Lab., Ill.
GRAIN-BOUNDARY MIGRATION IN POTASSIUM CHLORIDE BICRYSTALS
C. F. Gibbon Aug. 1966 21 p refs
(Contract W-31-109-ENG-38)
(ANL-7232) CFSTI: HC $3.00/MF $0.65

Boundary migration in melt-grown bicrystals of KCl containing pure twist boundaries was studied. A technique for investigating boundary mobility is outlined and applied. An unusually high activation energy, 4 to 6 eV, was found for movement of the twist boundaries. A related computation of twist-boundary energies in the rigid-lattice approximation indicated that the energy is insensitive to boundary misorientation in this approximation. Author (NSA)

N67-24579# France. Ministère de l'Air, Paris.
METHODS OF EXPERIMENTAL STUDY OF THE ZEEMAN EFFECT OF LONG RAYS IN THE ABSORPTION SPECTRA OF SOLIDS [METHODES D'ETUDE EXPERIMENTALE DE L'EFFET ZEEMAN DES RAIES LARGES DANS LE SPECTRE D'ABSORPTION DES SOLIDES]

Jean Margerie 1966 145 p refs In FRENCH
(NT-155) CFSTI: HC$3.00/MF$0.65

Transition probabilities in polarized light are measured in a study of the Zeeman effect in the absorption spectrum of solids. Application of the Zeeman effect is made to ruby spectrum of CaF_2: Sm++ (lines between 14,000 and 20,000 cm^{-1}) and F centers in KCl and KBr. Transl. by R.Li.

N67-24648# Naval Research Lab., Washington, D. C.
DETECTOR INVESTIGATION FOR 8–15 AND 100–4000 MICRON REGIONS Semiannual Technical Summary Report, 1 Jul.–31 Dec. 1966
H. Shenker Jan. 1967 58 p refs
(ARPA Order 269-62; Proj. Defender)
(NRL-MR-1743; AD-646927) CFSTI: HC$3.00/MF$0.65

Emphasis was placed on research on the preparation of Cd3As2, Zn3As2, and their alloy system. Successful growth of sound, single crystal ingots of the alloy system by the Bridgman technique was achieved. Successful epitaxial growth of Cd3As2 layers on alloy substrates was also achieved. The response of the InSb free electron (Rollin Detector) was extended into the 120 to 200 micron spectral region. By using high purity InSb intentionally doped with Se it was found that Rollin detectors usable at wavelengths as short as 80 microns could be obtained. The study of the magnetically tuned InSb detector was continued. It was found that operation in the longitudinal direction generally resulted in a detector having such a large noise that it was not usable. For a detector in the transverse configuration it was found that the responsivity for the high energy peak was consistent with the calculated responsivity based on a bolometer mechanism for this detector. It was found that the negative magnetoresistance effect in InSb was not dependent upon the lattice temperature but only upon the electron temperature of the sample. A copy of a paper entitled Magnetooptical Studies of Solids Using Fourier Transform Spectroscopy by R. Kaplan is included as an appendix. TAB

N67-24662# Iowa State Univ. of Science and Technology, Ames.
POSITRON ANNIHILATION IN RARE-EARTH SINGLE CRYSTALS
Ronald Wendell Williams Nov. 1966 87 p
(Contract W-7405-ENG-82)
(IS-T-112) CFSTI: HC$3.00/MF$0.65

The angular correlation curves of positron annihilation radiation from positrons annihilating in c-axis oriented single crystals of yttrium, gadolinium, terbium, dysprosium, holmium, erbium, and holmium-50%-erbium and b-axis oriented single crystals of yttrium and holmium were measured. The curves show the highly anisotropic nature of the Fermi surface and are found to be consistent with a model recently proposed by Loucks. A connection between the occurrence of antiferromagnetism in the metals and particular features of their Fermi surfaces is suggested. Humps occur in the angular correlation curves of dysprosium, holmium, and erbium c-axis oriented single crystals at room temperature and are indicative of flat electron and hole regions of their Fermi surfaces which run parallel to one another and normal to the c axis. No humps appear in the curves of gadolinium and terbium c-axis oriented crystals at room temperature and this suggests a modification of this particular feature of the Fermi surface. The close correlation between the curves of holmium, erbium, and holmium-50%-erbium seems to indicate that the rigid band model applies and that the concept of a Fermi surface is valid for the binary rare-earth alloys with hexagonal close packed structure. Author (NSA)

N67-24696# Cornell Univ., Ithaca, N. Y. Lab. of Atomic and Solid State Physics.
SOLID STATE PHYSICS: MAGNETIC PHENOMENA Progress Report, 1 Jan.–31 Dec. 1966
R. Bowers and R. H. Silsbee 31 Dec. 1966 12 p refs
(Contract AT(30-1)-2150)
(NYO-2150-22) CFSTI: HC$3.00/MF$0.65

The ESR spectrum of the excited ^2E state of Cr^{3+} and V^{2+} in MgO was determined. The observation of a Stark shift of the optical zero phonon line of the R_2 band in KCl is reported. After x-irradiation of a CN^- doped crystal and annealing, two paramagnetic centers were detected and tentatively identified as HCN^- and FCN^-. The presence of a strong paraelectric resonance in KCl:Li is suggested. The spin resonance of the localized Mn magnetic moments in CuMn alloys was investigated. The magneto-resistance of K single crystals was found to increase linearly with magnetic field. Hall coefficients were determined for several metals. Studies of Helicon wave propagation in metals and of low-frequency electromagnetic phenomena in superconductors are reported. NSA

N67-24753# Harvard Univ., Cambridge, Mass. Gordon McKay Lab.
MICROWAVE ABSORPTION SPECTRUM OF MAGNETICALLY ORDERED DYSPROSIUM METAL Scientific Report
Frederick Carl Rossol Nov. 1966 248 p refs
(Contract AF 19(628)-3874)
(AFCRL-66-666; SR-9; Ser. 3; AD-646572) CFSTI: HC $3.00/MF $0.65

The heavy rare earth metals all crystallize in a hexagonal close-packed structure and exhibit a tendency toward spatially periodic ordering of magnetic moments at low temperatures. An experimental study was made of the excited states in such magnetic systems for the various phases of ground state ordering. Dysprosium was chosen because of the relative simplicity of its ground state ordering and because of the abundance of experimental evidence concerning its static magnetic properties. Ferromagnetic resonance was observed at 37 Gc/sec by using the anisotropy in the hexagonal plane. The temperature dependence of the field for resonance gives a measure of the temperature dependence of the hexagonal anisotropy which is in good agreement with the behavior estimated from static measurements of magnetization. The most striking feature of this resonance absorption is its extremely large width. Absorption measured at temperatures in the spiral range with the field applied along an easy axis in the hexagonal plane shows an abrupt increase corresponding to a sharp rise in permeability at the field required to induce ferromagnetic ordering. This abrupt change is followed at higher fields by a gradual fall-off of absorption consistent with the increasing separation of the resonant frequency above the experimental frequency at higher fields. TAB

N67-24774# Naval Ordnance Lab., Corona, Calif.
PSEUDO-BREWSTER ANGLE TECHNIQUE FOR DETERMINING OPTICAL CONSTANTS
R. F. Potter 10 Jan. 1967 45 p refs
(NOLC-699; AD-647058) CFSTI: HC$3.00/MF$0.65

The pseudo-Brewster angle technique for measuring the optical constants of an opaque sample with a specular surface is described. A knowledge of the pseudo-Brewster angle phi-B at which the ratio (R-parallel)/(R-perpendicular) is a minimum and of the value of the minimum ratio at phi-B is sufficient to characterize the solid. An experimental procedure for determining these optical constants is presented, as well as a method of correcting for the presence of an oxide film layer. Results are shown of the pseudo-Brewster angle technique as applied to germanium. Author (TAB)

N67-24800# Royal Inst. of Tech., Stockholm (Sweden). Microwave Dept.
ELECTROMAGNETIC WAVES IN A POLAR SEMI-CONDUCTOR IN THE PRESENCE OF A MAGNETIC FIELD

Toshimitsu Musha 21 Dec. 1966 16 p refs
(Contract AF 61(052)-895)
(SR-14; RADC-TR-67-80; AD-646735) CFSTI: HC $3.00/MF $0.65

The dispersion relation for optical phonons in an isotropic polar crystal in a static magnetic field is calculated. Due to the polar electromechanical coupling the waves are affected by the magnetic field and instead of two degenerate linearly polarized branches two circularly polarized separate branches are obtained. Author (TAB)

N67-24858# Rutgers Univ., New Brunswick, N. J. Sch. of Ceramics.
PERFECTION OF SINGLE CRYSTAL ALUMINA GROWN IN R.F. PLASMAS AND BY OTHER TECHNIQUES Final Report, Jun. 1961–Jun. 1966
W. J. Alford, W. H. Bauer, and R. W. Matolka 14 Jun. 1966 92 p refs
(Contract AF 19(604)-8495)
(AFCRL-66-524; AD-647705) CFSTI: HC $3.00/MF $0.65

Several hybrid capacitive inductive r.f. plasma torches were developed for the growth of single crystal alumina by the Verneuil technique. A 3-tube torch with controlled mixtures of tangential and laminar flows provided good plasma stability and efficiency of powder deposition. Combined with an auxiliary heater and buffer gas flow, good crystal growth was obtained, using a 10KW generator at frequencies in the 15-25 megacycle range, and growth rates of 1/8-1/4 inch per hour. The dislocation densities and structures of crystals grown in plasmas of air, argon, nitrogen and oxygen were identical to crystals grown in oxy-hydrogen flames except for 90 degrees crystals. The difference in 90 degrees crystals is caused by the accumulation of a dense polycrystalline layer on the surface of plasma-grown crystals. The densities of prismatic and basal dislocations were about 700,000/sq and 2000000/sq cm, respectively. Dislocation densities measurements of alumina crystals grown by Czochralski hydrothermal, flux, and vapor deposition were one to two orders of magnitude lower than Verneuil crystals. An investigation of AlN-Al2O3 mixtures is described. A cubic form of alumina is obtained with small additions of AlN are added to Al2O3 and heated to high temperatures (1600C). The crystalline phases present were found to very markedly with firing temperature, atmosphere, and forming technique. Author (TAB)

N67-24868# Sperry Microwave Electronics Co., Clearwater, Fla.
LOW MAGNETIC SATURATION GARNETS Quarterly Progress Report, 1 Aug.–31 Oct. 1966
L. R. Hodges, Jr., W. R. Wilson, G. P. Rodrigue, and G. R. Harrison Ft. Monmouth, N. J., Army Electron. Command, Feb. 1967 36 p refs
(Contract DA-28-043-AMC-01205(E))
(ECOM-01205-7; QPR-7; Rept.-7; AD-647301) CFSTI: HC $3.00/MF $0.65

Nine single crystal runs consisting of YCaVIG, BiCaVIG and BiCaV(A1)IG were prepared and evaluated. The discrepancy in the magnetization versus composition between single and polycrystalline BiCaVIG appears to be resolved with the identification of Pb impurity in the single crystals. Three batches of (Bi1.0-x Y x)1.6Ca1.4V0.7Fe4.3O12 with x values of 0.15, 0.25, and 0.35 were prepared and all possessed lattice constants less than 12.540A. Two batches of Y1.6Ca2.4V0.7Al w Fe4.3-wO12 with w = 0.4 and 0.6 were made to determine the composition for the magnetic compensation point. The compensation point was found to occur at approximately w = 0.425. Composition G476, Bi0.4Ca2.6V1.3Al0.1Fe3.6O12 was remixed possessed a linewidth of 80 oersteds and a 4(pi)Ms of 530 gauss. The linewidth and magnetization as a function of temperature were found to be similar as expected for (Bi0.5Y0.5)0.4Ca2.6V1.3Fe3.7O12 and BiCaVIG y = 1.3. The magnetization of (Y0.5Gd0.5)0.6Ca2.4V1.2Fe3.8O12 varied approximately 1.65 gauss/deg. C from -100C to +200C. TAB

N67-24881# Illinois Univ., Urbana. Dept. of Physics.
CRITICAL FIELD OF SUPERCONDUCTING ALUMINUM AS A FUNCTION OF TEMPERATURE AND PRESSURE ABOVE 0.3°K
Erik Preston Harris Nov. 1966 112 p refs
(Contract DA-31-124-ARO(D)-359)
(AROD-2771-13; AD-645738) CFSTI: HC $3.00/MF $0.65

The critical field curve of aluminum was measured from T sub c to 0.3K, at pressures ranging from 0 to 7200 psi. Using calorimetrically derived values for the low-temperature superconducting electronic specific heat, the data were extrapolated to T = O, yielding values for H sub o and gamma. These values and experimental results for T sub c are then used to calculate the superconducting electronic entropy and the deviation of the critical field curve from parabolicity over the entire temperature range. The results show excellent agreement with previous calorimetric measurements of the thermodynamic properties of superconducting aluminum. The shape of the reduced critical field curve shows no pressure dependence over the range of pressures used. Author (TAB)

N67-24886# Union Carbide Corp., Tonawanda, N. Y. Linde Div.
HYDROTHERMAL GARNET CRYSTALS Final Report, 16 Jul. 1964–15 Jul. 1965
E. M. Flanigen 27 Dec. 1966 45 p refs
(Contract Nonr-4657(00); ARPA Order 306-62)
(AD-646231) CFSTI: HC $3.00/MF $0.65

The aim of this research was the hydrothermal growth of single crystals of grossular garnet, Ca3Al2Si3O12, containing divalent activator ions such as Eu, Sm, Gd, Ce and Mn. Such crystals were desired as possible new laser materials with efficient pumping and high fluorescent yield characteristics. Hydrothermal processes were successfully developed for growth of synthetic grossular on seeds and have yielded good quality fully synthetic crystals up to 3 mm x 5 mm x 9 mm. Incorporation of the rare earth ions Eu, Sm and Yb into the lattice under reducing conditions was achieved, but excitation and fluorescence spectra indicated the presence of only trivalent rare earth ions in the grossular crystals. Author (TAB)

N67-24908# St. Louis Univ., Mo.
ELECTRONIC AND NUCLEAR PARAMAGNETISM AND ENERGY EXCHANGE MECHANISMS Final Technical Report, Sep. 1965–Sep. 1966
Sook Lee and Vincent P. Jacobsmeyer Griffiss AFB, N. Y., RADC, Jan. 1967 78 p refs
(Contract AF 30(602)-2907)
(RADC-TR-66-627; AD-646620) CFSTI: HC $3.00/MF $0.65

Large F19 NMR enhancements in CaF2 crystals containing atomic hydrogen have been obtained from the various types of forbidden transition lines in the atomic hydrogen ESR spectrum. Investigations of the Solid State Effect in polycrystalline solids, in which ESR centers possess a substantially anisotropic g- and hyperfine tensors, have been conducted and predictions have been made pertaining to the NMR enhancements from such materials. In addition, double magnetic resonance experiments in polycrystalline NaCl containing Cl(2-) centers have been completed and studies to understand the behavior of the Al27 NMR enhancement in ruby crystals have been performed. Also, a new ESR spectrum in CaF2, when treated at high temperatures and in a hydrogen atmosphere, is reported. Author (TAB)

N67-24962# Massachusetts Inst. of Tech., Cambridge. National Magnet Lab.
MAGNET LABORATORY OPERATIONS Final Report, 1 Nov. 1964–31 Dec. 1966

Benjamin Lax and Arthur J. Freeman 30 Jan. 1967 48 p refs
(Contract AF 49(638)-1468)
(AFOSR-67-0522; AD-647421) CFSTI: HC $3.00/MF $0.65

During the contract period important improvements in the high field magnet facility were made. Continuous fields of 255 kilogauss in a very small volume, 225 kilogauss in a 1-1/4 inch bore and 205 kilogauss in a 2 inch bore are available. These are the highest continuous fields produced anywhere. More reliable superconducting magnets and high field, larger volume pulsed field magnets have also been developed. The Laboratory's research program in solid state and low temperature physics has improved understanding of the electrical, magnetic, optical and acoustic properties of matter. New and more sensitive techniques for magneto-optical studies such as electro-reflectance and piezo-reflectance and the use of laser sources have been developed and used to gain new information on the band structure of semiconductors. Studies of the new type II high field superconductors by a variety of techniques have revealed the factors which limit the usefulness of these materials for high field magnets. The magnetic properties of many solids have been explored by high field magnetization apparatus giving temperatures down to three millidegrees above absolute zero has been developed. Theoretical studies of band structure, crystal field theory, superconductivity and other topics have been carried on in close conjunction with the experimental program. Author (TAB)

N67-25011*# National Aeronautics and Space Administration, Washington, D. C.
PROBLEM OF THE EFFECT OF CAPTURE CENTERS ON THE PHOTOCONDUCTIVITY OF SEMICONDUCTORS AT HIGH ILLUMINATION LEVELS [K VOPROSU O VLIYANII TSENTROV PRILIPANIYA NA FOTOPROVODIMOST' POLUPROVODNIKOV PRI VYSOKIKH UROVNYAKH OSVESHCHENIYA]
D. A. Aronov and R. G. Shamasov Mar. 1967 7 p ref Transl. into ENGLISH from Izv. Akad. Nauk Uz. SSR, Ser. Fiz. Mat. Nauk (Tashkent), v. 10, no. 4, 1966 p 40–45
(NASA-TT-F-10785) CFSTI: HC $3.00/MF $0.65 CSCL 20L

Discussion of the calculation of photoconductivity in homogeneous semiconductors for certain cases in which the solution of the appropriate second-order nonlinear differential equations with indivisible variables can be obtained in elementary functions. Author

N67-25023*# International Information, Inc., Philadelphia, Pa.
PENETRATION OF 2 TO 11 KeV LITHIUM IONS INTO SILICON CARBIDE SINGLE CRYSTALS [PRONIKNOVENIYE IONOV LITIYA S ENERGIYEY 2–11 KeV V MONOKRISTALLY KARBIDA KREMNIYA]
V. V. Makarov and N. N. Petrov Washington, NASA, Feb. 1967 4 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Fiz. (Moscow), v. 30, no. 5, 1966 p 890–891
(Contract NASw-1499)
(NASA-TT-F-10777) CFSTI: HC $3.00/MF $0.65 CSCL 20L

The authors present results of an evaluation made of the penetration depth of 2–11 KeV lithium ions into single crystals of SiC of α-modification. Comparisons are made with the data obtained for the penetration of sodium ions into aluminum and the injection of H^+ and He^+ ions into aluminum. Author

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N67-23607# Institute of Modern Languages, Inc., Washington, D. C.
THE FORMATION OF PRECIPITATES IN REACTIVE FUELS [OBRAZOVANIE OSADKOV V REAKTIVNIKH TOPLIVAKH]
V. N. Zrelov and N. I. Marinchenko Ft. Belvoir, Va., Army Engr. Res. and Develop. Labs., Dec. 1966 11 p refs Transl. into ENGLISH from Neftepererabotka i Neftekhim., Nauchn.-Tekhn. Sb. (Moscow), no. 9, 1966 p 13–17
(Contract DA-44-009-AMC-1563(T))
(ERDL-T-1881-66; AD-645944) CFSTI: HC $3.00/MF $0.65

A report is given of an investigation of the composition of the precipitates formed in the Soviet T-1 and TC-1 reactive fuels after long-term storage at the temperature of the surrounding air and after heating up to 150C. TAB

N67-23653*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SOLID PROPELLANT ENGINEERING
In its Supporting Res. and Advanced Develop. 28 Feb. 1967 p 163–176 refs (See N67-23641 12-11)

Propellant binders terminated by acid chloride groups are investigated, as are the simplified interior ballistics of propellant actuated devices and motor development for the Application Technology Satellite (ATS). Exposure of dimer acid chloride to the atmosphere is graphed, and tables summarize data on dimer acid chloride curing with both epoxides and aziridines. An analysis is presented for a piston with simply defined motion, and the surface burning of single perforate propellants is shown to be very nearly constant. Storage units and testing of an omnidirectional antenna are considered for the ATS. Data from the four high speed cameras confirmed visual data that the antenna released and maintained a flight path along the motor centerline axis at least until it was past the region of the spacecraft VHF antennas. M.W.R.

N67-23795*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
EFFECT OF PROPELLANT-FEED-SYSTEM COUPLING AND HYDRAULIC PARAMETERS ON ANALYSIS OF CHUGGING
Don J. Wood and Robert G. Dorsch Washington, NASA, May 1967 24 p refs
(NASA-TN-D-3896) CFSTI: HC $3.00/MF $0.65 CSCL 21H

A digital distributed parameter model was used to study the effects of propellant feed system coupling and various hydraulic parameters on the analytical prediction of chugging instabilities. Coupling between the combustion chamber and feed system was controlled by varying the compliance of the injector-dome region. The coupling with the feed system above the pump was varied by changing the amount of cavitation compliance at the pump inlet. The stability limits and chugging frequencies proved to be strongly dependent on the degree of feed system coupling. The maximum stability condition occurred with intermediate coupling. Under conditions of a high degree of feed system-combustor coupling, the stability limits and chugging frequencies were primarily dependent on the feed system characteristics; the responses were characterized by beating patterns. Under conditions of maximum feed system coupling, the magnitude and distribution of fine losses in the discharge line had a significant effect on the stability limits but had negligible effect on the chugging frequency and beating characteristics. A resistive-shunt device attached to the pump discharge line to suppress chugging was effective under conditions of high feed system coupling. Author

N67-23985 Weapons Research Establishment, Salisbury (Australia).
THE PROPERTIES AND SPECIFICATION TESTING OF UNSYMMETRICAL-DIMETHYL HYDRAZINE
N. V. Ayres and L. A. Pearson Dec. 1965 26 p refs
(WRE-TN-CPD-107) CFSTI: $3.00

This note summarises the chemical and physical properties of unsymmetrical dimethyl hydrazine (U.D.M.H.) and discusses the methods to be used in testing U.D.M.H. to ensure conformity to the relevant American and French Specifications for rocket fuels. Laboratory sampling techniques have been developed to ensure that U.D.M.H. is not contaminated by the atmosphere during testing. The test methods are modified, where necessary, to conform to standard laboratory practice and to use equipment conforming to British Standards for fuel testing equipment. The properties of a pure sample of U.D.M.H. have been determined by these methods and the results obtained were consistant with the specified properties. The results obtained show that there should be no difficulty in testing U.D.M.H. to specifications. Author

N67-24017# Naval Research Lab., Washington, D. C.
THE EFFECT OF ULLAGE ON THE FLASH POINT AND LOWER FLAMMABILITY LIMIT TEMPERATURES OF JP-5 JET FUELS
Wilbur A. Affens and Homer W. Carhart Nov. 1966 12 p refs
(NRL Memo-1735; AD-645046) CFSTI: HC$3.00/MF$0.65

From theoretical considerations it can be shown that the relative size of the free-space (ullage) above a liquid fuel mixture can be a significant factor in the flammability properties of such a system. A simple apparatus has been used to test the effect of ullage on flash point and lower flammability limit temperatures of JP-5 jet fuels. Results indicate that both ullage and time to achieve equilibrium conditions are factors. In general, flammability limit temperatures decreased with decreasing ullage, the rate and magnitude of the decrease depending on the composition of the fuel. Thus, at smaller ullages, flammability hazard is increased. In one instance, the extrapolated flammability temperature of a specification JP-5 jet fuel was 26F lower than its ASTM flash point as ullage approached zero. The data suggest that both the rate of temperature decrease with decreasing ullage, and the limiting value at zero ullage are important information in evaluating flammability properties of JP-5 fuel mixtures. Author (TAB)

N67-24381# Wissenschaftliche Gesellschaft für Luft- und Raumfahrt, Cologne (West Germany).
SESSION REPORT OF THE WGLR ENGINE FUEL COMMITTEE [BERICHT UEBER DIE SITZUNG DES WGLR-FACHAUSSCHUSSES TREIBSTOFFE]
30 Sep. 1966 244 p refs In GERMAN Symp. held in Trauen, West Germany, 2–3 Dec. 1965
(DLR-Mitt.-66-14) CFSTI: HC$3.00/MF$0.65

CONTENTS:

1. SHORT REPORT ON METHODS AND POSITION OF THE THEORY OF CONSUMPTION OF SOLID PROPELLANTS R. Damm (Deutsche Versuchsanstalt fuer Luft- und Raumfahrt) p 7–25 refs (See N67-24382 12-27)

2. ENERGY BALANCE AND CONSUMPTION PRINCIPLE H. Selzer et al (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt) p 27–34 refs (See N67-24383 12-27)

3. ON THE EFFICIENCY OF WASTE ACCELERATION USING COMPOSITE SOLID PROPELLANTS Schubert et al p 35–42 (See N67-24384 12-27)

4. PERFORMANCE IN MANUFACTURE, PREPARATION AND CRUSHING OF OXIDATION SALTS FOR COMPOSITES AND EFFECTS IN PRODUCTION AND BALLISTIC PROCESSES Pichl et al p 43–57 (See N67-24385 12-27)

5. POSSIBILITY OF EFFICIENCY INCREASE USING SOLID PROPELLANTS A. Dadieu et al p 59–67 refs (See N67-24386 12-27)

6. STANDARD COMBUSTION CHAMBERS E. Krebs p 69–92 (See N67-24387 12-27)

7. COMBUSTION STABILITY IN NORMAL CHAMBER ROCKETS Penner et al p 93–101 (See N67-24388 12-27)

8. DISCONTINUITY IN THE COMBUSTION MECHANISM OF COMPOSITE PROPELLANTS H. Selzer et al p 103–116 refs (See N67-24389 12-27)

9. THE DETERMINATION OF DATA FOR ESTIMATING THE SECURITY OF CHEMICAL ROCKET PROPELLANTS IN MANUFACTURE AND UTILIZATION E. Haeuseler et al p 117–140 refs (See N67-24390 12-27)

10. PROBLEMS OF FRONT BURNERS P. Semmler et al p 141–145 (See N67-24391 12-27)

11. PROBLEMS OF FRONT BURNERS H. Schubert and H. Toepfer (Bolkow Entwicklungen k.g.) p 147–161 (See N67-24392 12-27)

12. THE INFLUENCE OF THE COMBUSTION CHAMBER WALLS ON FIRING E. Krebbs et al p 163–170 (See N67-24393 12-27)

13. THE HEAT CONDUCTIVITY OF COMPOSITE PROPELLANTS H. Selzer et al p 171–181 refs (See N67-24394 12-27)

14. MEASUREMENT OF CROSS THRUST COMPONENTS IN MEPPEN E. Krebs p 183–188 (See N67-24395 12-27)

15. ON THE CAUSES OF ACCIDENTAL CROSS THRUST COMPONENTS IN SOLID PROPELLANT TRANSMISSIONS K. Schadow p 189–207 refs (See N67-24396 12-27)

16. SIX COMPONENTS TEST-STAND FOR ROCKET TRANSMISSION RESEARCH L. Reichl et al (Bolkow Entwicklungen k.g.) p 209–222 (See N67-24397 12-27)

17. COMBUSTION OF CIRCULAR CHARGES WITH INVOLUTE-SHAPED COMBUSTION SURFACES G. Siegmund p 223–224 (See N67-24398 12-27)

18. MEASUREMENT OF INTERIOR BALLISTIC CHARACTERISTICS OF ROCKET PROPELLANTS UNDER HIGH PRESSURE IN CLOSED COMBUSTION SHELL R. Rudolph et al p 225–235 (See N67-24399 12-27)

N67-24382# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Stuttgart (West Germany). Institut fuer Raketentreibstoffe.
SHORT REPORT ON METHODS AND POSITION OF THE THEORY OF CONSUMPTION OF SOLID PROPELLANTS [KURZBERICHT UEBER METHODEN UND STAND DER THEORIE DES ABBRANDES VON FESTTREIBSTOFFEN]
R. Damm *In* WGLR Session Rept. of the WGLR Engine Fuel Comm. 30 Sep. 1966 p 7–25 refs (See N67-24381 12-27)

The theories of the combustion mechanism are discussed using the following three examples: (1) the theory of Rice and Ginnel for the combustion of homogeneous propellants, which treats the combustion process as a one-dimensional stationary problem; (2) the theory of Summerfield et al. for the combustion of composites, using as an example the burning process of ammonium perchlorate grains in a plastic binder; and (3) the theory of Nachbar, which is based on a two-dimensional sandwich model for a block of propellant and oxidizer discs. The three theories are critically reviewed. Transl. by K.W.

N67-24383# Deutsche Forschungsanstalt für Luft- und Raumfahrt, Bochum (West Germany).
ENERGY BALANCE AND CONSUMPTION PRINCIPLE [ENERGIEBILANZ UND ABBRANDGESETZ R(P)]
H. Selzer et al *In* WGLR Session Rept. of the WGLR Engine Fuel Comm. 30 Sep. 1966 p 27–34 refs (See N67-24381 12-27)

Discussed is the reduction of the mass of a solid propellant due to combustion. The energy balance at the propellant surface is calculated with several small but significant modifications in the parameters of kinetics and temperature, and the equation for surface temperature and combustion velocity is derived. The dependence of the equation on the pressure parameter is examined.

Also considered are the effects of initial propellant storage temperature, catalysts, and metallic additives. Transl. by K.W.

N67-24384# Wissenschaftliche Gesellschaft für Luft- und Raumfahrt, Cologne (West Germany).
ON THE EFFICIENCY OF WASTE ACCELERATION USING COMPOSITE SOLID PROPELLANTS [UEBER DIE WIRKSAMKEIT VON ABBRANDBESCHLEUNIGERN BEI COMPOSITE-FESTTREIBSTOFFEN]
Schubert et al *In its* Session Rept. of the WGLR Engine Fuel Comm. 30 Sep. 1966 p 35–42 (See N67-24381 12-27)

The effectiveness of additives for accelerating the burning process of ammonium perchlorate propellants with polyurethane binders was investigated. Experiments were conducted to verify the effects of metals, perchlorates, copper chromite, silicon dioxide, silicate, and titanium-organic compounds on propellants containing ammonium perchlorate. Additive percentages for achieving maximum burning velocity were determined, particularly through concurrent use of silicon dioxide and copper chromite. The propellant-to-binder ratios were varied, and results of an experiment with fine-grain propellant are given. Transl. by K.W.

N67-24385# Wissenschaftliche Gesellschaft für Luft- und Raumfahrt, Cologne (West Germany).
PERFORMANCE IN MANUFACTURE, PREPARATION AND CRUSHING OF OXIDATION SALTS FOR COMPOSITES AND EFFECTS IN PRODUCTION AND BALLISTIC PROCESSES [AUSFUEHRUNGEN UEBER HERSTELLUNG, VORBEREITUNG UND ZERKLEINERUNG VON OXIDATIONSSALZEN FUER COMPOSITE UND EINFLUSSNAHME AUF DEREN FERTIGUNGSGANG UND BALLISTIK]
Pichl et al *In its* Session Rept. of the WGLR Engine Fuel Comm. 30 Sep. 1966 p 43–57 (See N67-24381 12-27)

Chemical composition, production, and combustion characteristics are given for the most important oxidizer salts used in composite solid propellants. Specifically discussed are ammonium nitrate and ammonium perchlorate. Drying, crushing, and analytical control of grain size are described. Several German-made mills used in the grinding process are shown and their capacities are discussed. Transl. by K.W.

N67-24386# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Stuttgart (West Germany). Institut fuer Raketentreibstoffe.
POSSIBILITY OF EFFICIENCY INCREASE USING SOLID PROPELLANTS [MOEGLICHKEITEN DER LEISTUNGSSTEIGERUNG BEI FESTTREIBSTOFFEN]
A. Dadieu et al *In* WGLR Session Rept. of the WGLR Engine Fuel Comm. 30 Sep. 1966 p 59–67 refs (See N67-24381 12-27)

Considered are possibilities for increasing the energy output of homogeneous double-base powders, heteogeneous composite powders, binders, and softeners. The means for such increases are reviewed, among them: (1) increasing the nitroglycerine contents; (2) improvement of such oxidizers as nitrosyl perchlorate, hydrazine mononitrate, hexanitroethane, and particularly nitronium perchlorate; (3) nitration of binders and softeners, chiefly using nitrocellulose; and (4) addition of light metal powders. Energy data obtained through addition of various metal powders of hydrides to ammonium perchlorate-polyethylene composites are shown in a table. Transl. by K.W.

N67-24387# Wissenschaftliche Gesellschaft für Luft- und Raumfahrt, Cologne (West Germany).
STANDARD COMBUSTION CHAMBERS [NORMBRENNKAMMERN]
E. Krebs *In its* Session Rept. of the WGLR Engine Fuel Comm. 30 Sep. 1966 p 69–92 (See N67-24381 12-27)

Efforts to improve an existing standardized combustion chamber for testing solid propellants are described. The chamber is to be used in conjunction with a standard test method by all German organizations engaged in propellant testing. Methods and results of preliminary measurements conducted at various installations are compared, and differences in the results are examined. Transl. by K. W.

N67-24388# Wissenschaftliche Gesellschaft für Luft- und Raumfahrt, Cologne (West Germany).
COMBUSTION STABILITY IN NORMAL CHAMBER ROCKETS [ABBRANDINSTABILITAETEN IN RAKETEN-NORMKAMMERN]
Penner et al *In its* Session Rept. of the WGLR Engine Fuel Comm. 30 Sep. 1966 p 93–101 (See N67-24381 12-27)

The problem of instability in the combustion of solid propellants is defined, and the validity of combustion chamber experiments is evaluated when the results of such model tests are applied to large rocket motors combustion. Experiments were conducted with five different double-base propellants. Sets were tested in the lengths of 50, 80, 100, 150, and 200 mm. The propellants were chosen so as to have a calculated isobaric flame temperature of 1900°K and 2200°K. It was found that the threshold pressure for unstable combustion depends strongly on the linear combustion velocity of the propellant. The propensity of short propellant sets toward stable combustion is also briefly examined. Transl. by K.W.

N67-24389# Deutsche Forschungsanstalt für Luft- und Raumfahrt, Bochum (West Germany).
DISCONTINUITY IN THE COMBUSTION MECHANISM OF COMPOSITE PROPELLANTS [UNSTETIGKEITEN IM ABBRANDMECHANISMUS VON COMPOSITE-TREIBSTOFFEN]
H. Selzer et al *In* WGLR Session Rept. of the WGLR Engine Fuel Comm. 30 Sep. 1966 p 103–116 refs (See N67-24381 12-27)

Investigations were made to obtain quantitative data on the phases occurring during the combustion process. For this purpose, experiments were conducted with two solid propellants: a composition of 85% ammonium perchlorate, 13% polyisobutylene, and 2% additives; and a composition of 78% ammonium perchlorate, 21% polyurethane, and 1% additives. Photographic measurements with varying exposure times were made in the macro-range to determine surface regression on propellant discs. Temperature measurements of the bright surface particles were made by a method in which the brightness of the particles was compared with the molten droplets of a wire imbedded in the propellant. The ammonium perchlorate–polyurethane propellant was also examined for flow velocities of the flame gases near the surface at pressure ranges up to 150 kp/cm^2, and the existence of a reaction rhythm was proven. Transl. by K.W.

N67-24390# Wissenschaftliche Gesellschaft für Luft- und Raumfahrt, Cologne (West Germany).
THE DETERMINATION OF DATA FOR ESTIMATING THE SECURITY OF CHEMICAL ROCKET PROPELLANTS IN MANUFACTURE AND UTILIZATION [DIE ERMITTLUNG VON KENNDATEN ZUR BEURTEILUNG DER SICHERHEIT VON CHEMISCHEN RAKETENTREIBSTOFFEN BEI FABRIKATION UND ANWENDUNG]
E. Haeuseler et al *In its* Session Rept. of the WGLR Engine Fuel Comm. 30 Sep. 1966 p 117–140 refs (See N67-24381 12-27)

Safety measures during fabrication, transport, and handling of liquid and solid propellants are reviewed, and methods are

discussed for determining propellant sensitivity to thermal effects, mechanical stresses, and shock waves. Tabulated data are presented for double-base nitrocellulose nitroglycerine propellants and for composites with perchlorate as oxidizer. The data include ignition temperatures, friction and impact sensitivities, and detonation wave propagation. Transl. by K.W.

N67-24391# Wissenschaftliche Gesellschaft für Luft- und Raumfahrt, Cologne (West Germany).
PROBLEMS OF FRONT BURNERS [PROBLEME DES STIRNBRENNERS]
P. Semmler et al *In its* Session Rept. of the WGLR Engine Fuel Comm. 30 Sep. 1966 p 141–145 (See N67-24381 12-27)

Advantages and disadvantages of end-burning solid propellant sets are pointed out, and possible means for eliminating some of the problems are discussed. The use of wires imbedded in the propellant to increase the combustion velocity is reviewed. Velocity data are included for silver, copper, tungsten, platinum, aluminum, magnesium, and steel wires. Transl. by K.W.

N67-24392# Bolkow Entwicklungen K. G., Munich (West Germany).
PROBLEMS OF FRONT BURNERS [PROBLEME DES STIRNBRENNERS]
H. Schubert and H. Toepfer *In* WGLR Session Rept. of the WGLR Engine Fuel Comm. 30 Sep. 1966 p 147–161 (See N67-24381 12-27)

Covered are end-burning solid propellant sets with one and two combustion surfaces, coupled end-burning sets, and perforated sets with the combustion perpendicular to the direction of gas flow. The adaptability of end burners to rocket configurations is discussed as well as their special suitability for several rocket propulsion requirements. Energy limitations, problems of case bonding, and gas flow conditions in the space between propellant and restrictor wall are examined. It is concluded that end burners continue to be the best solid propulsion mode for sustained combustion in small-caliber rockets and for long-distance flights. But since currently available powders permit only a sustained flight velocity of Mach 1.2, an increase in the burning rate by a factor of 4 to 6 is required. Transl. by K.W.

N67-24393# Wissenschaftliche Gesellschaft für Luft- und Raumfahrt, Cologne (West Germany).
THE INFLUENCE OF THE COMBUSTION CHAMBER WALLS ON FIRING [DIE EINFLUSS DER BRENNKAMMERWAENDE AUF DIE VERBRENNUNG]
E. Krebs et al *In its* Session Rept. of the WGLR Engine Fuel Comm. 30 Sep. 1966 p 163–170 (See N67-24381 12-27)

The effects of heat transfer in the walls of combustion chambers on the ignition of solid propellants are investigated. Experience had shown that ignition failures occurred in thick-walled chambers, especially at low temperatures. This was contrary to heat flux and distribution theories according to which steel walls thicker than 1.5 mm have no effect on propellant ignition. The problem was examined using data from Comet rocket firings with thin-walled steel chambers and from firings in thick-walled test chambers. Results are also given of firing tests conducted with Cobra launch rockets in which steel and light metal chambers were used. The test were made at temperatures of −31°C and +21°C. Application of the heat transfer equations are briefly reviewed. Transl. by K.W.

N67-24394# Deutsche Forschungsanstalt für Luft- und Raumfahrt, Bochum (West Germany).
THE HEAT CONDUCTIVITY OF COMPOSITE PROPELLANTS [DIE WAERMELEITFAEHIGKEIT VON COMPOSITE-TREIBSTOFFEN]
H. Selzer et al *In* WGLR Session Rept. of the WGLR Engine Fuel Comm. 30 Sep. 1966 p 171–181 refs (See N67-24381 12-27)

The heat transfer equation is used to demonstrate the dependence of heat conductivity on temperature, and measurements to that effect were performed on pressed sets of ammonium perchlorate, ammonium perchlorate–polyurethane, and ammonium perchlorate–polyisobutylene propellants. Measurements were confined to the temperature range from 20°C to 130°C. The extrapolation of these data and applications are discussed. Transl. by K.W.

N67-24395# Wissenschaftliche Gesellschaft für Luft- und Raumfahrt, Cologne (West Germany).
MEASUREMENT OF CROSS THRUST COMPONENTS IN MEPPEN [MESSUNG VON SCHUBQUERKOMPONENTEN IN MEPPEN]
E. Krebs *In its* Session Rept. of the WGLR Engine Fuel Comm. 30 Sep. 1966 p 183–188 (See N67-24381 12-27)

Development of a hydraulic-electric system is described for measuring side thrust components of rockets. The system will register side thrust forces of millisecond duration while disregarding high-frequency combustion oscillations, and short thrust pulses as well as prolonged static forces can be measured. Application of the system in testing military 11-cm solid propellant rockets is shown. Transl. by K.W.

N67-24396# Deutsche Forschungsanstalt für Luft- und Raumfahrt, Bochum (West Germany).
ON THE CAUSES OF ACCIDENTAL CROSS THRUST COMPONENTS IN SOLID PROPELLANT TRANSMISSIONS [UEBER DIE URSACHEN VON ZUFAELLIGEN QUERSCHUBKOMPONENTEN BEI FESTSTOFFTRIEBWERKEN]
K. Schadow *In* WGLR Session Rept. of the WGLR Engine Fuel Comm. 30 Sep. 1966 p 189–207 refs (See N67-24381 12-27)

Summarized and discussed are causes and methods for determining side thrust forces on solid propellant rockets. A review of the aerodynamic forces acting on the rocket is followed by an analysis of side thrust forces caused by faulty construction and production. Thrust components due to chemical, gasdynamical, and thermodynamical processes are examined, including nozzle flow, combustion instability, and combustion chamber characteristics. Transl. by K.W.

N67-24397# Bolkow Entwicklungen K. G., Munich (West Germany).
SIX COMPONENTS TEST-STAND FOR ROCKET TRANSMISSIONS RESEARCH [6-KOMPONENTENPRUEFSTAND FUER RAKETENTRIEBWERKSUNTER SUCHUNGEN]
L. Reichl et al *In* WGLR Session Rept. of the WGLR Engine Fuel Comm. 30 Sep. 1966 p 209–222 (See N67-24381 12-27)

The test stand is designed for solid propellant rockets with a thrust of 1000 kp, and it serves to determine thrust vector deviations from the geometrical nozzle axis. Described are mechanical facilities, calibration of the measuring system, determination of the geometrical nozzle axis, measuring process, design of the piezoelectric components of the system, and computer facilities for processing the measured data. Transl. by K.W.

N67-24398# Wissenschaftliche Gesellschaft für Luft- und Raumfahrt, Cologne (West Germany).
COMBUSTION OF CIRCULAR CHARGES WITH INVOLUTE-SHAPED COMBUSTION SURFACES [ABBRAND VON RINGLADUNGEN MIT EVOLVENTENFOERMIGER BRENNFLAECHE]

G. Siegmund *In its* Session Rept. of the WGLR Engine Fuel Comm. 30 Sep. 1966 p 223–224 (See N67-24381 12-27)

Described is a test in which the combustion process of a slotted, ring-burning solid propellant disc was filmed. The disc was 20 cm in diameter, 2 cm thick, and had an insulated core. The combustion progressed at a constant rate, regardless of the initial shape of the slot. Transl. by K.W.

N67-24399# Wissenschaftliche Gesellschaft für Luft- und Raumfahrt, Cologne (West Germany).

MEASUREMENT OF INTERIOR BALLISTIC CHARACTERISTICS OF ROCKET PROPELLANTS UNDER HIGH PRESSURE IN CLOSED COMBUSTION SHELL [MESSUNG INNENBALLISTISCHER EIGENSCHAFTEN VON RAKETENTREIBSTOFFEN BEI HOEHEREN DRUECKEN IN DER GESCHLOSSENEN VERBRENNUNGSBOMBE]

R. Rudolph et al *In its* Session Rept. of the WGLR Engine Fuel Comm. 30 Sep. 1966 p 225–235 (See N67-24381 12-27)

A fast test method for determining the combustion behavior of a solid propellant at pressures up to 2000 kp/cm^2 is described. The linear combustion velocity is derived from the spatial combustion velocity of propellant grain whose size is known. The spatial combustion velocity can thus be determined in a closed combustion chamber as a constant function of pressure. A combustion chamber of 50 cm^3 volume was used to test a flake powder. Load density varied between 0.5 and 0.20 g/cm^3. Illustrations of test arrangements as well as graphs and tables with the test results are included. Transl. by K.W.

N67-24839# Atlantic Research Corp., Alexandria, Va. Kinetics and Combustion Group.

RESEARCH ON THE DEFLAGRATION OF HIGH-ENERGY SOLID OXIDIZERS Quarterly Technical Summary Report, Sep. 1–Nov. 30, 1966

G. von Elbe 30 Dec. 1966 13 p refs

(Contract AF 49(638)-1645)

(AFOSR-67-0382; QTSR-4; AD-646758) CFSTI: HC $3.00/MF $0.65

Work was initiated on the study of the self-deflagration of hydroxylammonium perchlorate (HAP), and the investigation of solid-oxidizer and propellent extinguishment. The effort to present has principally been devoted to design and construction of apparatus, preliminary calculations and acquiring and analyzing HAP. Progress along these lines is outlined. Author (TAB)

N67-24960# Naval Research Lab., Washington, D. C.

USE OF THE HYSTERESIS LOOP METHOD TO STUDY THIXOTROPIC SUSPENSIONS. PART 1: BEN-A-GEL/WATER SYSTEM

J. T. Leonard and R. N. Hazlett 24 Jan. 1967 26 p refs

(NRL-6486; AD-647354) CFSTI: HC $3.00/MF $0.65

The rheological behavior of aqueous suspensions of Ben-a-gel, a highly purified magnesium montmorillonite, was studied by the hysteresis loop method. It was found that the plastic viscosities of these suspensions could be related to concentration by Arrhenius' law at low concentrations or Weltmann and Green's equation at higher concentrations. The transition from one exponential law to the other occurs at about 1.1 vol-% of Ben-a-gel, the concentration at which the gel strength is sufficiently developed so that the suspension no longer flows from an inverted container. The values for the various yield points characterizing the hysteresis loop also bear exponential relationships to concentration and show similar transitions at about 1.1 vol-% of Ben-a-gel. The results of the study indicate that Arrhenius law may be used in conjunction with Weltmann and Green's equation to describe the rheological behavior of an ideal thixotropic suspension over a concentration range covering both the pregelation and postgelation regions. Author (TAB)

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N67-23656*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

LIQUID PROPULSION

In its Supporting Res. and Advanced Develop. 28 Feb. 1967 p 224–237 refs (See N67-23641 12-11)

Propellant atomization, injector hydraulics, and resonant combustion investigations are reviewed. In view of the qualitatively identical behavior of the fully resonant mode exhibited by the engine during spontaneous or bomb-induced modes, it is concluded that the bombing technique does not significantly influence the character of the sustained wave. This conclusion may not apply to all cases because the engine used in the present study had long injector orifices to control the hydraulic conditions. This results in byproducts that are high impedance flow systems and relatively insensitive to the effects of the rapidly varying chamber pressure, as from a bomb pulse. The atomization and hydraulics study describes some experiments on the feasibility of using the optical diffraction of a monochromatic light source to find the droplet distribution inside a burning rocket motor. The optical arrangement is found suitable for producing interference patterns of either opaque or transluscent objects of about 20 to 2000 μ in size. M.W.R.

N67-23951*# Electro-Optical Systems, Inc., Pasadena, Calif.

ELECTRON BOMBARDMENT CESIUM ION ENGINE SYSTEM Summary Report, 3 May 1965–16 Dec. 1966

G. Sohl, V. V. Fosnight, and S. J. Goldner Apr. 1967 198 p refs

(Contract NAS3-7112)

(NASA-CR-54711; EOS-6954-Summary) CFSTI: HC $3.00/MF $0.65 CSCL 21C

Development of a 1-kilowatt ion engine system is reported. This system, including a discharge neutralizer and "zero-gravity" feed system, produced 6.7 millipounds thrust at 5000 seconds specific impulse. Two systems were life tested for 3700 and 8200 hours, respectively, until exhaustion of their cesium supplies. A permanent magnet engine designed for operation at the same level as the life test engines and weighing only 1.6 lb is described. A fourth engine, which was built around the concept of an ac discharge, and controls for this engine, which automatically regulated the discharge power at its optimum level, are also reported. Author

N67-24483# Library of Congress, Washington, D. C. Aerospace Technology Div.

PROPULSION TECHNOLOGY Monthly Survey No. 3

Dec. 1966 59 p refs

(ATD-66-143; TT-67-61133; AD-647598) CFSTI: HC $3.00/MF $0.65

The survey is based on Soviet, Satellite, and CHICOM open sources published in 1966. It is the third in a series of monthly reports and deals with air breathing and rocket propulsion technology and the related nonchemical aspects of combustion. The report is divided into three sections. Section I (Review of the literature of the Warsaw-Pact countries) covers three types of information: Air breathing propulsion (1) Rotating engines--17 articles); Rocket propulsion (1) Liquid rocket propulsion--3 articles; (2) Solid rocket propulsion--2 articles; (3) Rocket engine concepts and applications--1 article); Combustion engineering (1) Subsonic

combustion of fuel and air--8 articles; (2) Combustion of liquid rocket propellants--4 articles; (3) Combustion of solid rocket propellants--7 articles). Section II (Review of Communist Chinese literature) covers only air breathing propulsion with two articles on rotating engines. Section III lists 17 source documents. Author (TAB)

N67-24827*# Hughes Research Labs., Malibu, Calif.
LOW WORK FUNCTION CATHODE DEVELOPMENT Summary Report
W. Knauer and H. Gallagher Oct. 1966 131 p refs
(Contract NAS3-7114)
(NASA-CR-54682) CFSTI: HC$3.00/MF$0.65 CSCL 21C

Emphasis was focused upon developing low work function cathodes designed to endure intensive ion bombardment and to remain in an equilibrium state of activation over long time periods while subjected to a discharge environment. The environmental factors affecting the performance of a cathode in a discharge were assessed, and it was found that the presence of a plasma sheath adjacent to the cathode is of major importance. Design concepts were evaluated. Flower and disk cathode configurations, along with a nickel encapsulated powder type of active material, were evolved to combine safe operation and sufficient material storage for long cathode life. The operating principles are discussed briefly. Experimental results of evaluation and life tests are detailed. Results indicate that 10,000 hour missions using flower cathodes are possible. Nickel encapsulated cathode powder, used for coating the flower cathodes, provided improved coating adhesion and reduced coating resistance. M.G.J.

N67-24831*# Aerojet-General Corp., Sacramento, Calif.
260-SL-3 MOTOR PROGRAM. VOLUME I: 260-SL-3 MOTOR INTERNAL INSULATION SYSTEM Final Phase Report
28 Apr. 1967 70 p refs
(Contract NAS3-7998)
(NASA-CR-72228) CFSTI: HC$3.00/MF$0.65 CSCL 21H

Motor 260-SL-3 was insulated with V-44 rubber. The design configuration was based on the V-44 rubber thickness-loss-rate data obtained during the previous motor static test firings. Previously fired and rehabilitated forward and aft insulation from another motor case were used in motor 260-SL-3. Unusable cylindrical-section rubber and damaged forward- and aft-head insulation were removed from the case. New cylindrical-section insulation, propellant boot, and aft-boot extension components were fabricated by layup of unvulcanized V-44 on a mandrel and cure in an autoclave. Repair of existing insulation and installation of new insulation components were accomplished. Author

N67-25060*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
MEASUREMENT OF PERFORMANCE, INLET FLOW CHARACTERISTICS, AND RADIATED NOISE FOR A TURBOJET ENGINE HAVING CHOKED INLET FLOW
Jimmy M. Cawthorn, Garland J. Morris, and Clyde Hayes Washington, NASA, May 1967 45 p refs
(NASA-TN-D-3929) CFSTI: HC$3.00/MF$0.65 CSCL 21E

Engine and inlet performance and sound measurements were made during tests with a small turbojet engine equipped with a three-dimensional, variable geometry supersonic inlet. Tests were made for a range of inlet areas obtained by translating the inlet centerbody. No increase in engine vibration was observed with the inlet choked and no erratic engine behavior was noted when the inlet was rapidly unchoked. For each centerbody position some engine performance losses were incurred at the lowest speed at which the inlet choked. The losses increased rapidly as engine speed was increased above the choking speed for each centerbody location, and the rapid increase in exhaust gas temperature to the maximum allowable value prevented further increases in engine speed over the normal operational range. Choking occurred at a value of total pressure ratio of approximately 0.93 for the range of centerbody positions at which the inlet could be choked. Total-pressure loss and low velocities near the outer duct wall were found to result from the sharp leading edge with the centerbody located near the design position. Noise measurements indicated that choking the inlet flow was beneficial in reducing the noise levels forward of the engine. Author

N67-25068*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
LIQUID PROPELLANT THERMAL CONDITIONING SYSTEM Interim Report
W. H. Sterbentz 20 Apr. 1967 268 p refs
(Contract NAS3-7942)
(NASA-CR-72113; LMSC-A839783) CFSTI: HC $3.00/MF $0.65 CSCL 21H

A venting system concept is described that will efficiently control tank pressures during zero-gravity coast periods by venting vapor overboard. In this concept, referred to as a liquid propellant thermal conditioning system, tank fluid is extracted, expanded to a lower temperature and pressure, and passed through a heat exchanger where it absorbs heat from the bulk propellant and the ullage in the tank. Potential component candidates were defined for use as fluid removal units, expansion units, heat exchanger units, and propellant mixer units. Details are given on systems concepts and parametric analyses, propellant mixing requirements, system design method, application of design method, systems optimization, and selected system design and performance. L.E.W.

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N67-23745# Brookhaven National Lab., Upton, N. Y.
NUCLEAR SPECTROSCOPY AND SOLAR NEUTRINO ASTROPHYSICS
G. E. Kocharov and Yu. N. Starbunov [1966] 14 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR (Moscow), Ser. Fiz. no. 30, 1966 p 1090–1094
(BNL-TR-118) CFSTI: HC$3.00/MF$0.65

The detection of solar neutrinos will give an experimental confirmation of the hypothesis of the thermonuclear origin of stellar energy and determine the temperature in the core of the sun. It is shown that the accuracy in determining the temperature in the sun's interior chiefly depends on the excited state characteristics of a number of nuclei and on the magnitude of certain nuclear reaction cross sections in the super-low energy region. NSA

N67-23762# Universidad Nacional Autonoma de Mexico, Villa Obregon.
NON-THERMAL SOLAR RADIATION [RADIACION NO TERMICA DEL SOL]
Humberto Arriola Santamaria 1965 53 p refs In SPANISH
(NP-16433) CFSTI: HC$3.00/MF$0.65

The processes for the production of energy within the sun are analyzed and the energy transport mechanism leading to the production of solar flares is reviewed. The various types of radio-frequency explosions taking place in the sun are described. A mechanism for the production of flares from the annihilation of the magnetic field is analyzed. NSA

N67-23827# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON PERIODICITIES OF SOLAR ACTIVITY

Chen Biao and Chun-lin Yin 28 Sep. 1966 15 p refs Transl. into ENGLISH from Tien Wen Hsueh Pao (Guozi Shudian), v. 13, no. 1, 1965 p 89–96

(FTD-HT-66-115; TT-67-60303; AD-644061) CFSTI: HC $3.00/MF $0.65

The smoothed monthly mean relative sunspot numbers from 1750 to 1960 inclusive were used in this paper to derive their periodicities. Based on the two periods obtained, an approximation expression for the relative numbers was found. TAB

N67-23834# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE BEHAVIOR OF RADIATION BELTS AND ANOMALOUS ABSORPTION OF COSMIC RADIO NOISE IN THE ZONE OF THE POLAR AURORA DURING THE MAGNETIC STORMS OF 12–14 FEBRUARY AND 20–21 FEBRUARY 1964

S. N. Vernov, V. M. Driatskiy et al 12 Sep. 1966 16 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 6, no. 1, 1966 p 3–10

(FTD-HT-66-304; TT-67-60304; AD-644063) CFSTI: HC $3.00/MF $0.65

The behavior of the external radiation belt and also the case of anomalous absorption of cosmic radio noise in the zone of the polar aurora during the magnetic storms of 12-14 and 20-21 February 1964 are studied. The behavior of the external radiation and belt anomalous absorption of cosmic radio noise with different phases of magnetic storms are compared. TAB

N67-23905*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

A STUDY OF LOW ENERGY GALACTIC COSMIC RAYS FROM 1961 TO 1965

Bonnard John Teegarden (Ph.D. Thesis–Maryland Univ.) Jan. 1967 119 p refs

(NASA-TM-X-55761; X-611-67-8) CFSTI: HC $3.00/MF $0.65

The cosmic ray intensity was measured on a balloon borne dE/dx and E detector sensitive to energies from 15 to 80 MeV/nucleon. Proton and helium intensities at 85 MeV/nucleon are given for the five year balloon flight period. The behavior of the proton to helium ration as a time function is discussed within the framework of Parker's model for the solar modulation of cosmic ratio A cosmic ray helium spectrum from 60 to 500 MeV/nucleon measured by a modified version of the detector is presented. The change in proton and helium intensities in this energy range is examined and compared with results predicted by Parker's model. An empirical atmospheric secondary proton spectrum is derived based on simultaneous balloon and satellite measurements, compared with the secondary spectrum obtained from a nuclear emulsion measurement, and the differences discussed. Using this spectrum, an upper limit for the reentrant albedo at Sioux Falls is obtained which is much less than previous values. Secondary deuterium and tritium intensities were measured and a value obtained for the global average production of tritium in the earth's atmosphere. Author

N67-23997# Max-Planck-Institut fur Aeronomie, Lindau uber Northeim (West Germany).

ON THE CHARACTERISTICS OF GEIGER COUNTERS AND IONIZATION CHAMBERS IN VARIOUS RADIATION FIELDS. INTERPRETING X-RAY MEASUREMENTS AT BALLOON ALTITUDES IN THE AURORAL ZONE [UEBER DIE EIGENSCHAFTEN VON ZAEHLROHREN UND IONISATIONSKAMMERN IN VERSCHIEDENARTIGEN STRAHLUNGSFELDERN. ZUR INTERPRETATION VON ROENTGENSTRAHLUNGSMESSUNGEN IN BALLONHOEHE IN DER NORDLICHTZONE]

Erhard Keppler 1965 64 p refs In GERMAN; ENGLISH summary (Rept.-20) CFSTI: HC $3.00/MF $0.65

Since measurements of auroral zone X-rays by balloon-borne detectors are usually performed in atmospheric depths of several g/cm^2, the reduction of the measured X-ray energy spectrum to the energy spectrum of the primary electron spectrum involves several uncertainties. A simple method is derived to get spectral information on the source spectrum from the measurements immediately by reducing the measured energy spectrum of X-rays to the source spectrum at zero absorber thickness neglecting Compton scattering. The influence of this simplification is discussed, the frame of validity described, and an estimate on probable errors given. Bremsstrahlung spectra have been calculated for exponential type electron spectra. A comparison of the calculated bremsstrahlung spectrum with the measured bremsstrahlung spectrum allows an approximation of the measured spectrum in terms of different electron spectra represented by different folding energies. This has been especially done for scintillation counters with discriminator biases equivalent to 20, 40, and 100 keV. A combination of a single Geiger counter and an ionization chamber has also been investigated; here Compton scattering is included into the calculations to a certain extent. Conclusions drawn from measurements, which have been performed by Geiger counters of different cathode materials (Al and Bi), are discussed. A reduction to a mean exponential energy spectrum at zero atmospheric depth is given. Author

N67-24321 Czechoslovak Academy of Sciences, Prague. Astronomical Inst.

THIRD CONSULTATION ON SOLAR PHYSICS AND HYDRODYNAMICS

M. Kopecky, ed. 1965 244 p refs Consultation held in Tatranska Lomnica, Czechoslovakia, 13–16 Oct. 1964

(Publ.-51)

Papers on the corona, sunspots, flares, and the solar atmosphere and magnetic field are presented. For individual titles see N67-24322–N67-24360.

N67-24322 Czechoslovak Academy of Sciences, Prague. Astronomical Inst.

ON THE PROBLEM OF ENERGY TRANSFER IN THE SUN

C. Popovici *In its* 3d Consultation on Solar Phys. and Hydrodyn. 1965 p 9–10 refs (See N67-24321 12-29)

The inability of the temperature gradient, computed on the hypothesis of radiative or convective equilibrium and uniform chemical composition, to explain the central temperature needed for nuclear energy generation is discussed. Means of raising the adiabatic temperature gradient are reviewed, including partial ionization, radiation pressure, increasing the mean molecular gradient towards the center, and the convective phenomena. N.E.N.

N67-24323 Czechoslovak Academy of Sciences, Prague. Astronomical Inst.

POLARIZATION MEASUREMENTS OF SOLAR SPECTRAL LINES

F. W. Jaeger *In its* 3d Consultation on Solar Phys. and Hydrodyn. 1965 p 11–16 refs (See N67-24321 12-29)

Details are presented on a photoelectric recording photometer designed to eliminate instrumental polarization and other disturbing effects. Previous investigations applying the theory of resonance fluorescence to solar phenomena are reviewed, and the role of electron scattering is mentioned. Recent observations described are the Ca I resonance line 4227 Å, prominences of H and K line of Ca II, H-alpha line of the chromosphere near the solar limb. N.E.N.

N67-24324 Czechoslovak Academy of Sciences, Prague. Astronomical Inst.

TITANIUM ABUNDANCE IN THE SOLAR ATMOSPHERE

V. Letfus *In its* 3d Consultation on Solar Phys. and Hydrodyn. 1965 p 17–21 refs (See N67-24321 12-29)

Determinations of the abundance of Ti I and Ti II in the solar atmosphere are discussed and compared for both local and nonlocal thermodynamic equilibrium. A table is given of previously published results from several methods of calculation. It was concluded that: (1) The good agreement between the data of the absolute scale gives a possibility of determining the absolute *f*-value scale for complex spectra. (2) The equal abundance values for lines Ti I and Ti II show that any nonlocal thermodynamic equilibrium in ionization is negligible, and the *f*-sum rule is not quite satisfactory for higher transitions. (3) Using the Corliss and Bosman absolute scale and the Allen and Corliss correction, the most probable titanium abundance value for Claas' solar photosphere model is log A+12=4.75. N.E.N.

N67-24325 Czechoslovak Academy of Sciences, Prague. Astronomical Inst.

THE MAGNETIC FIELD AND MOTIONS OF GASES IN THE SOLAR ATMOSPHERE

V. A. Krat *In its* 3d Consultation on Solar Phys. and Hydrodyn. 1965 p 22–23 (See N67-24321 12-29)

The results of measurements of magnetic fields in the chromosphere and photosphere are summarized. Among the findings are: the existence of regular photospheric magnetic fields; no large scale wave motion in the chromosphere; a magnetic density of the elements of the chromosphere 35 times larger than in the photosphere; measurements of the displacement of the magnetic field of a sunspot in the chromosphere from the sunspot in the photosphere; and mean gradient measurements of the magnetic field in the low chromosphere. N.E.N.

N67-24326 Czechoslovak Academy of Sciences, Prague. Astronomical Inst.

ON THE FINE-SCALE DISTRIBUTION OF SOLAR MAGNETIC FIELDS

V. Bumba and Robert Howard *In its* 3d Consultation on Solar Phys. and Hydrodyn. 1965 p 24–26 refs (See N67-24321 12-29)

Fine-scan magnetograms were obtained of six regions of the solar surface during the period 1959–1962. Daily calcium spectroheliograms were used for comparison with chromospheric features. In the case of stronger fields within an active region, a complicated wiggly line was found which follows the shape of the supergranular pattern. Large regions of intermediate field strength were seen to include both polarities, with the predominant polarity flux concentrated around the boundaries of the supergranules and the opposite polarity appearing weakly in the cell's center. Two magnetic polarities are also reported for the weakest regions, but the polarities are mixed and there is little difference between the fluxes of the two polarities. N.E.N.

N67-24327 Czechoslovak Academy of Sciences, Prague. Astronomical Inst.

GENERAL MAGNETIC FIELD OF THE SUN DERIVED FROM BABCOCK'S MAGNETOGRAMS

I. K. Csada *In its* 3d Consultation on Solar Phys. and Hydrodyn. 1965 p 27–31 (See N67-24321 12-29)

The solar magnetic field components are calculated, and a model structure of the field is discussed. Poloidal and toroidal field components are taken into account, and the results are graphed and tabulated. It was concluded that: the symmetric and antisymmetric quadrupole terms are very small and play no role in solar magnetic field and the dipole terms are considerable in magnitude and are important in the magnetic field analysis. N.E.N.

N67-24328 Czechoslovak Academy of Sciences, Prague. Astronomical Inst.

REMARKS ON BABCOCK'S EXPLANATION OF THE SUN'S MAGNETIC FIELD

F. Krause *In its* 3d Consultation on Solar Phys. and Hydrodyn. 1965 p 32–35 refs (See N67-24321 12-29)

A simplified model of bipolar sunspot groups is presented in which the convection zone of one hemisphere of the sun is idealized by a flat plate and a shearstreaming with a constant gradient is used for the differential rotation. The characteristics of the curves of relative numbers of sunspots are mentioned. It is suggested that the dynamo action with given limitations holds for the magnetic field, and that the dynamo action results from the asymmetry of the poloidal flux production in relation to the time of greatest production. N.E.N.

N67-24329 Czechoslovak Academy of Sciences, Prague. Astronomical Inst.

MODELS OF MAGNETOHYDRODYNAMIC DYNAMOS FOR ALTERNATING FIELDS

F. Krause and M. Steenbeck *In its* 3d Consultation on Solar Phys. and Hydrodyn. 1965 p 36–38 refs (See N67-24321 12-29)

A flat plate of a magnetohydrodynamic medium undergoing a shearstreaming with constant gradient representing differential rotation is considered as an idealized model of the alternating solar magnetic field. It is suggested that the feedback mechanism may arise from turbulence, and that the velocity gradient is unequal to zero throughout the whole convection zone. N.E.N.

N67-24330 Czechoslovak Academy of Sciences, Prague. Astronomical Inst.

PRELIMINARY COMPUTATIONS CONCERNING THE CONSTRUCTION OF DETAILED MODELS OF SUNSPOTS

J. Jakimieg and M. Zabza *In its* 3d Consultation on Solar Phys. and Hydrodyn. 1965 p 39–40 refs (See N67-24321 12-29)

A sunspot model is briefly described which uses the thermodynamic parameters and magnetic field expression of a previously published model and an additional assumption limiting the magnetic field. It was found that the temperature distribution is incompatible with a real sunspot, and it is suggested that the computation of such a model should begin with an assumption of the temperature distribution across the model. N.E.N.

N67-24331 Czechoslovak Academy of Sciences, Prague. Astronomical Inst.

VARIATION OF THE AVERAGE PENUMBRA–UMBRA RATIO OF SUNSPOTS DURING THE SOLAR CYCLE

L. Dezsoe and O. Gerlei *In its* 3d Consultation on Solar Phys. and Hydrodyn. 1965 p 41–45 refs (See N67-24321 12-29)

The manner in which the mean penumbra–umbra ratio of sunspot groups varies with time during the solar cycle is discussed. Data from the years 1886–1955 were used, considering only spot groups observed five or more days. The calculations are briefly described, and the results are graphed. It is shown that the ratio generally follows the sunspot activity, and it is suggested that the penumbral–umbral variable area quotient should be recognized as an important parameter of sunspot phenomenon. N.E.N.

N67-24332 Czechoslovak Academy of Sciences, Prague. Astronomical Inst.

THE FINE STRUCTURE OF THE BUTTERFLY DIAGRAMS

M. Kopecky *In its* 3d Consultation on Solar Phys. and Hydrodyn. 1965 p 46 refs (See N67-24321 12-29)

It is pointed out that recently published discussions of the fine structure of butterfly diagrams arrive at markedly different conclusions from each other and from classical interpretation. It is

therefore recommended that a solution be found to the true fine structure problem for designing hydromagnetic models of sunspot periodicity. N.E.N.

N67-24333 Czechoslovak Academy of Sciences, Prague. Astronomical Inst.

DISTRIBUTION OF SUNSPOTS IN HELIOGRAPHIC LATITUDE FOR ELEVEN-YEAR CYCLE

M. N. Gnevyshev and A. Antalova *In its* 3d Consultation on Solar Phys. and Hydrodyn. 1965 p 47–48 refs (See N67-24321 12-29)

Previously published data on sunspot distribution was extended and the data are graphed. Two different methods of superposition of normalized curves were used: different eleven-year cycles were superposed so that years of maximum activity coincide, and the data were also superposed so that the years of appearance of new cycle spots coincide. It is shown why the mean curve of a typical solar cycle cannot be obtained by taking the maxima of different cycles as the starting zero points. N.E.N.

N67-24334 Czechoslovak Academy of Sciences, Prague. Astronomical Inst.

AN INTERPRETATION POSSIBILITY OF THE EAST-WEST ASYMMETRIC DISTRIBUTIONS OF SUNSPOTS OVER THE SUN'S DISK

L. Dezsoe *In its* 3d Consultation on Solar Phys. and Hydrodyn. 1965 p 49–57 refs (See N67-24321 12-29)

A possible explanation of the preponderance of the increasing sunspot areas on the eastern half of the solar disk and of the preponderance of the decreasing spots on the western half is outlined. It is concluded that all kinds of observed asymmetric east–west distributions of sunspots can be explained, at least qualitatively, by the existence of nontransparent faculae. The facular east–west asymmetry is also considered to cause the other east–west asymmetries found in observational data of different solar phenomena. N.E.N.

N67-24335 Czechoslovak Academy of Sciences, Prague. Astronomical Inst.

SOME REMARKS ON THE DATE OF THE ACTUAL SOLAR ACTIVITY MINIMUM

Vasile Dinulescu *In its* 3d Consultation on Solar Phys. and Hydrodyn. 1965 p 58–61 refs (See N67-24321 12-29)

Observations of 1963–1964 sunspots are discussed with respect to activity minimum. The intersection of decay and rise curves, the mean relative numbers, and superposed cycles are emphasized. It was determined that rotation 1482 was the rotation in which minimum solar activity was attained. N.E.N.

N67-24336 Czechoslovak Academy of Sciences, Prague. Astronomical Inst.

CZECHOSLOVAK MONOCHROMATIC FILTERS FOR CHROMOSPHERIC OBSERVATIONS

Boris Valnicek *In its* 3d Consultation on Solar Phys. and Hydrodyn. 1965 p 62–68 refs (See N67-24321 12-29)

The design and optical characteristics of two Lyot–Ohman-type and one Solc-type filters are presented. The first filter, made of eight quartz elements, has a 27 mm working diameter, half-width on filter maximum 0.96 Å, an operating temperature of 32°C, and a total intensity of 10.5% of the primary maximum for the first four secondary maxima. The second filter, of seven quartz elements, has a working diameter of 45 mm, permits high convergence of beams and is used for prominence observations. The Solc-type filter consists of 40 mm diameter, 145 mm long quartz section and a limestone part 38 mm in diameter, and has a half-width for the whole filter of 0.90 Å. Graphs are included of the photometric profiles of the principal maximum. N.E.N.

N67-24337 Czechoslovak Academy of Sciences, Prague. Astronomical Inst.

K AND H LINES OF IONIZED CALCIUM IN AN ACTIVE REGION OF THE SOLAR DISK

J. Paciorek *In its* 3d Consultation on Solar Phys. and Hydrodyn. 1965 p 69–88 refs (See N67-24321 12-29)

A complete series of profiles for strong chromospheric spectral lines, which shows the entire change of the shape from the profiles for an undisturbed sun through the whole active region above the sunspot, is presented. The data analyzed were from a plate with spectra containing the central parts of the K-line 3933.68 Å and H-line 3968.49 Å. Two series of profiles were obtained for several distances from the center of the spot. Graphs are presented of observed and theoretical profiles of the K-line, and of the cross section of the sunspot in the wing of the K-line. From the reduced data, it was noticed that: (1) The shape of the emission changes continuously from the undisturbed sun profile to profiles with only one peak. (2) The changes in shape of the emission do not show symmetry towards the center of the spot. (3) The emission with the single maximum peak lies far beyond the sunspot umbra. Comparison of theoretical and observed profiles suggests that the theory of Thomas and Jefferies describes qualitatively the entire range of shapes of emission, and that the form depends on the rate of temperature increase in the chromosphere. N.E.N.

N67-24338 Czechoslovak Academy of Sciences, Prague. Astronomical Inst.

D_3-LINE IN SOLAR FLARES

P. Kubes *In its* 3d Consultation on Solar Phys. and Hydrodyn. 1965 p 89–90 (See N67-24321 12-29)

A table is presented of D_3-line data from 8 flares, including half-width, Doppler broadening, emission and absorption, velocity of nonthermal motion for kinetic temperature of 15,000°K, and number of ortho-helium atoms. The data are briefly discussed, emphasizing the roles played by turbulence and self-absoption. N.E.N.

N67-24339 Czechoslovak Academy of Sciences, Prague. Astronomical Inst.

DETERMINATION OF THE ELECTRON DENSITY IN FLARES

Z. Svestka *In its* 3d Consultation on Solar Phys. and Hydrodyn. 1965 p 91 refs (See N67-24321 12-29)

The determination of electron density using the H_{10} to H_{15} lines of the Balmer series and taking into account electron damping is briefly reported. The electron density of a 3^+ flare in the flash state was found as high as $4 \times 10^{13}/cm^3$ and was noted to decrease to 50% of the value during fifteen minutes of flare development. N.E.N.

N67-24340 Czechoslovak Academy of Sciences, Prague. Astronomical Inst.

ON SOME STATISTICAL PARTICULARS OF FLARE OCCURRENCE IN ACTIVE REGIONS

E. Tifrea *In its* 3d Consultation on Solar Phys. and Hydrodyn. 1965 p 92–94 refs (See N67-24321 12-29)

The frequency of flares in active centers with a rapid development and with a great flare activity during 1957, 1958, 1960, and 1961 are briefly discussed. The east–west asymmetry effect was found in 54% of the regions in the earlier years but only in 31% for the later years. N.E.N.

N67-24341 Czechoslovak Academy of Sciences, Prague. Astronomical Inst.

ON THE FILAMENTARY STRUCTURE OF FLARES

Z. Svestka *In its* 3d Consultation on Solar Phys. and Hydrodyn. 1965 p 95–97 refs (See N67-24321 12-29)

The determination of the number of two-quantum hydrogen atoms over 1 cm^2 of the base of the flare, by calculating the electron density using the method of half-widths, is outlined. It is suggested that the flares cannot be formed by a compact layer of radiating matter, but must be conglomerates of bright excited flare elements, or filaments, and colder interflare matter. N.E.N.

N67-24342 Czechoslovak Academy of Sciences, Prague. Astronomical Inst.

INTERDEPENDENCE OF SUNSPOT PROPER MOTIONS AND CHROMOSPHERIC FLARES

A. Antalova *In its* 3d Consultation on Solar Phys. and Hydrodyn. 1965 p 98–99 (See N67-24321 12-29)

The interdependence was found in a 10° zone above the sunspots, and a ribbon shape was noted for most of the flares. The acceleration and area changes of the sunspots the day after the flare are mentioned. Graphs are included for one example. N.E.N.

N67-24343 Czechoslovak Academy of Sciences, Prague. Astronomical Inst.

THE INFLUENCE OF FILAMENTARY STRUCTURE OF PROMINENCES AND FLARES ON THE LINE PROFILES

T. Ciurla and B. Rompolt *In its* 3d Consultation on Solar Phys. and Hydrodyn. 1965 p 100–114 refs (See N67-24321 12-29)

Mathematical expressions are developed for calculating the line profiles, based on known emitted intensity and optical thickness for each filament, and the calculated profiles are graphed. For simplicity, only two filaments were considered, and it was assumed that the radiation from the filament farther from the observer is partially absorbed by the filament lying nearer the observer. Brief discussions of several of the profile shapes are included, and problem areas in the profile analysis are identified. It is concluded that the preliminary results indicate that the model will account for observational facts such as the large Doppler widths of prominence and flare lines. N.E.N.

N67-24344 Czechoslovak Academy of Sciences, Prague. Astronomical Inst.

PROMINENCE MOTIONS

P. Palus *In its* 3d Consultation on Solar Phys. and Hydrodyn. 1965 p 115–119 (See N67-24321 12-29)

The trajectories and motions of three prominences of September 12, 1956, which were processed from the dynamic point of view, are discussed. Two prominences, which consisted of knots moving from the coronal space towards the chromosphere, were observed for 11 minutes. The third, observed for 30 minutes, was considerably more complex, being a violent eruption repeated with enhanced activity a few minutes later. Each is described briefly in terms of volume, mass, velocity of knots and streamers, acceleration, energy distribution over the trajectory, and force acting upon the knots and streamers. Diagrams are presented of the motions and trajectories of the knots and threads. N.E.N.

N67-24345 Czechoslovak Academy of Sciences, Prague. Astronomical Inst.

THE CONNECTION BETWEEN A FUNNEL-TYPE PROMINENCE AND SURGES

B. Rompolt *In its* 3d Consultation on Solar Phys. and Hydrodyn. 1965 p 120–124 *ref* (See N67-24321 12-29)

The trajectories and directions of mass motions and the general character of the magnetic field in the region of active prominences are discussed. The prominences used in the study were situated at the western solar limb on November 22, 1945. It was assumed that the matter moved along the magnetic lines of force. The surges appeared to be the main supplier of matter to the corona. The material within the funnel was noted to align itself along the magnetic lines in the shape of relatively stable streams in contrast to the short-lived surge phenomenon. Characteristic values of the velocity of matter and the extreme values of surge velocities are tabulated. It was also observed that all surges emerged from the region of solar surface where two systems of magnetic lines of force converge. N.E.N.

N67-24346 Czechoslovak Academy of Sciences, Prague. Astronomical Inst.

ON THE PHOTOMETRY OF CORONAL EMISSION LINES

J. Laxa *In its* 3d Consultation on Solar Phys. and Hydrodyn. 1965 p 125–129 ref (See N67-24321 12-29)

Details are presented on the coronal spectrograph, photographic method, film processing, and the line measurement. The coronal lines 5303 and 6374 Å were measured for intensity every day weather permitted. Photographs were made in the IInd order of spectrum through a yellow filter which cuts out the IIIrd order UV portion. Corrections for measured intensities are given. It is concluded that measurements show the fine structure of the monochromatic corona and that the standard measurements give overall information on intensity distribution. Observations indicate that if intensities are low, the errors are about 2 to 3 units, and about 3 to 5 units if the intensities are high. N.E.N.

N67-24347 Czechoslovak Academy of Sciences, Prague. Astronomical Inst.

MAGNETIC FIELDS IN CORONAL SPACE

J. Kleczek *In its* 3d Consultation on Solar Phys. and Hydrodyn. 1965 p 130–132 (See N67-24321 12-29)

A few observational facts on the structure and changes of magnetic fields in the corona are mentioned, limited to H-alpha filtrograms and spectrograms, and K and 5303 Å filtrograms. Prominence and corona phenomena are listed, including loops, chromospheric motions, quiescent filaments, oscillations, and structural changes. N.E.N.

N67-24348 Czechoslovak Academy of Sciences, Prague. Astronomical Inst.

MAGNETO-HYDRODYNAMIC DISCUSSION OF THE EXPANDING CORONA

I. K. Csada *In its* 3d Consultation on Solar Phys. and Hydrodyn. 1965 p 133–136 (See N67-24321 12-29)

The velocity field of the expanding corona is discussed in terms of the temperature distribution, based on isophotes. The magnetic dipole variation with expansion and the general magnetic field are calculated and the results are graphed. It is suggested that in the maximum activity phase, the loops of the toroidal lines play an essential role in the plasma physics rate of coronal heating. N.E.N.

N67-24349 Czechoslovak Academy of Sciences, Prague. Astronomical Inst.

THE STATE OF THE OUTER SOLAR CORONA BETWEEN 1961 AND 1964

S. Gorgolewski *In its* 3d Consultation on Solar Phys. and Hydrodyn. 1965 p 137–140 refs (See N67-24321 12-29)

The relation between the scattering angle and the apparent distance of the Tau A from the sun was determined from the 32 MHz Tau A occultation curves. Using the coronal scattering at the E–W base line, the dependence on time was derived. It was found that solar activity and scattering angle changes are well correlated at distance ranging from 20 to 30 R. The results are graphed and are briefly discussed. N.E.N.

N67-24350 Czechoslovak Academy of Sciences, Prague. Astronomical Inst.

ON THE SHAPE AND ORIENTATION OF THE OUTER SOLAR CORONA

Z. Turlo, S. Gorgolewski, and J. Hanasz *In its* 3d Consultation on Solar Phys. and Hydrodyn. 1965 p 141–144 refs (See N67-24321 12-29)

Radiowave scattering by electron irregularities in the corona was used to study the outer corona structure at distances from 10 to 100 $R_{\odot}$. The solar activity, the solar motion toward the apex, and the galactic magnetic field were considered for influences on the shape and extension of the corona. It is concluded that the coronal asymmetry is due primarily to the dynamic pressure of the interstellar gas, and that solar activity and the galactic magnetic field influences are small or negligible. N.E.N.

N67-24351 Czechoslovak Academy of Sciences, Prague. Astronomical Inst.

SINGULARITIES IN THE CONTINUOUS EMISSION OF A PLASMA

G. Wallis *In its* 3d Consultation on Solar Phys. and Hydrodyn. 1965 p 145–154 refs (See N67-24321 12-29)

Observations of resonances at the harmonics of the gyrofrequency are summarized, and the continuous radio emission coming from the solar active regions is discussed. Measurements at discharge plasmas and resonances on topside ionograms are reviewed. Details are given on the modification of the curves for the refractive index for the simplest case of propagation perpendicular to the magnetic field. The magnetic energy densities corresponding to each wave range are compared with the kinetic energy density in the chromosphere and corona. The following alternatives are suggested: (1) The magnetic influence on electromagnetic wave generation and propagation is concentrated on the lower harmonics of the gyrofrequency. (2) Or, there must exist essential spectral pecularities at higher harmonics which must be explained with the aid of the kinetic dispersion relation for electromagnetic waves. N.E.N.

N67-24352 Czechoslovak Academy of Sciences, Prague. Astronomical Inst.

WAYS OF SPREADING PERTURBING AGENTS IN CHROMOSPHERE AND CORONA, WHICH GENERATE INTENSITY CHANGES OF SOLAR RADIO-EMISSION

I. Garczynska *In its* 3d Consultation on Solar Phys. and Hydrodyn. 1965 p 155 (See N67-24321 12-29)

Assuming that the self-oscillations of the electron plasma are responsible for the changes in intensity of solar radio emission, two models of electron density distribution in the solar atmosphere are considered in relation to the spreading of perturbing agents in the chromosphere and corona. On the basis of experimental data, the velocity of the perturbing agents for both models was found. It was shown that the perturbations of radio emission that correspond to strong chromospheric flares are connected with geomagnetic storms of the SC type. When geomagnetic storms of the SC type are not observed, it is assumed that the velocities of streams are small and the velocities of perturbing agents can be calculated with the model of the quiet atmosphere. L.E.W.

N67-24353 Czechoslovak Academy of Sciences, Prague. Astronomical Inst.

POSITIONS AND RADIOINTENSITY OF SOLAR ACTIVE CENTRES BASED ON E-W INTERFEROMETRIC OBSERVATIONS

Z. Turlo *In its* 3d Consultation on Solar Phys. and Hydrodyn. 1965 p 156–159 *ref* (See N67-24321 12-29)

The observations of solar active centers by two-aerial east-west 94 λ interferometers working at a frequency of 127 MHz are reported. The observations were made during a period of minimum activity, and the information was obtained from measurements of the phase, amplitude, and mean period of the interferometric record of the sun. The instrument is described, and the motion of active centers is briefly discussed as well as observations of the active center from August 14 to August 19, 1964. L.E.W.

N67-24354 Czechoslovak Academy of Sciences, Prague. Astronomical Inst.

ON THE APPARENT COINCIDENCE BETWEEN RADIO PROPAGATION AND CELESTIAL MECHANICS

E. Chvoikova *In its* 3d Consultation on Solar Phys. and Hydrodyn. 1965 p 160–161 refs (See N67-24321 12-29)

It is pointed out that although the basic formulas governing radio paths are identical with Kepler's fundamental laws governing celestial mechanics, the idea that radio paths could be derived from the formulas used in celestial mechanics is wrong. The reason for this is stated to be in the media deviating radio and particle paths respectively. The gravity field is a very simple function of radius while the electron distribution, defining the ray path, is usually a very complicated function of radius. Author

N67-24355 Czechoslovak Academy of Sciences, Prague. Astronomical Inst.

ON THE CORRELATION BETWEEN 810 McS RADIO BURSTS AND CHROMOSPHERIC FLARES

J. Machalski and S. Zieba *In its* 3d Consultation on Solar Phys. and Hydrodyn. 1965 p 162–168 refs (See N67-24321 12-29)

A 7 m parabolic radiotelescope was used to record radio emission from the whole solar disc to ascertain the correlation between solar radio bursts and chromospheric flares. The period of the study included 3710 hours from the beginning of October 1957 to the end of December 1960. From analysis of the data, it was concluded that (1) At high frequencies radio bursts resulting from flares predominate. (2) The number of bursts correlated with flared decreases with increasing wavelength. (3) The total number of bursts at first decreases and after reaching some minimum, increases again to a value even greater than the initial one. In order to determine the spectral type of 810 Mc/s radio bursts, a diagram was drawn in which the maximum intensity is plotted against the duration of the radio burst. From the duration of the radio bursts and the time intervals between the beginning of the flare and of the burst, it was concluded that there occur bursts of short duration with a very short time interval and bursts of long duration and high intensity produced by flares of importance 3 and 3+. L.E.W.

N67-24356 Czechoslovak Academy of Sciences, Prague. Astronomical Inst.

SOME REMARKS ON THE X-RAY SOLAR BURSTS

J. Mergentaler *In its* 3d Consultation on Solar Phys. and Hydrodyn. 1965 p 169–170 refs (See N67-24321 12-29)

Summary data are given on a preliminary model constructed to explain the behavior of radio and X-ray bursts connected with solar flares at various longitudes. L.E.W.

N67-24357 Czechoslovak Academy of Sciences, Prague. Astronomical Inst.

SHAPE DIFFERENCES IN THE WEAK AND STRONG SLOW CORPUSCULAR STREAMS OF FLARES

L. Fritzova-Svestkova *In its* 3d Consultation on Solar Phys. and Hydrodyn. 1965 p 171–175 refs (See N67-24321 12-29)

Consideration is given to the properties of the trails of the corpuscular streams ejected by great flares. Previously collected data were divided into flares without magnetic storms, flares followed by weak storms, and flares with strong storms. The dependences of the number of flares on their distance from the central meridian were traced out for each of these groups. The main properties of the slow corpuscular streams ejected by the flares were summarized in the following way: (1) The corpuscular streams ejected by the chromospheric flares that cause geomagnetic storms probably cause the type IV radio bursts. (2) The corpuscular streams are ejected into a great space angle which is greater for weaker storms. (3) The concentration of particles in the radial direction is greater in the stronger streams. (4) The weaker streams reach the earth first when they are ejected by flares situated on the west limb of the sun. (5) The weaker streams have a lower speed. L.E.W.

N67-24358 Czechoslovak Academy of Sciences, Prague. Astronomical Inst.

SPACE MODEL OF A CLOUD OF SOLAR COSMIC AND SUBCOSMIC PARTICLES

L. Krivsky *In its* 3d Consultation on Solar Phys. and Hydrodyn. 1965 p 176–183 refs (See N67-24321 12-29)

Background information is reviewed on solar flares with emanating cosmic rays and the effects of polar cap absorption (PCA). Using these data, a cloud model is proposed on the assumption that flares situated at 20° to 30°E often emit the compact part of the limb of a deflected cloud of high velocity solar particles toward the earth. This is composed of subcosmic rays, which is able to produce some PCA-effect on the earth. In such cases, the central parts of the cloud containing relatively higher velocity particles of cosmic rays pass east of the earth. A diagram is presented of the geometric situation of the cloud in the plane of the terrestrial orbit, from which the effective angle of the particle outflow, its half-width, and its width at the distance of the terrestrial orbit are calculated. Several cases are also included for assessment. L.E.W.

N67-24359 Czechoslovak Academy of Sciences, Prague. Astronomical Inst.

ON FORCE-FREE FIELDS IN THE SOLAR ATMOSPHERE AND THE INTERPLANETARY SPACE

G. Wallis *In its* 3d Consultation on Solar Phys. and Hydrodyn. 1965 p 184–188 refs (See N67-24321 12-29)

A previously published stability concept drawn from the variational formulation for the stability of hydromagnetic equilibria is reviewed, and a model for the force-free stability with regard to the magnetic fields in solar active regions and interplanetary space is developed. The model of solar corpuscular streams takes into consideration the interaction of plasma clouds with the magnetosphere and the earth's ionosphere. The strong magnetic fields in the chromosphere are discussed, along with the quadrupole fields which fit with observations of photospheric magnetic fields. The limitations of the force-free model and the variational formulation are emphasized. N.E.N.

N67-24360 Czechoslovak Academy of Sciences, Prague. Astronomical Inst.

TRAJECTORIES OF CHARGED PARTICLES IN THE MAGNETIC AND GRAVITY FIELDS WITH APPLICATIONS TO PLANETARY NEBULAE, NOVAE AND ERUPTIVE PROMINENCES

E. Chvojkova *In its* 3d Consultation on Solar Phys. and Hydrodyn. 1965 p 189 refs (See N67-24321 12-29)

The freezing of a charged particle in a given point of the magnetic field line along which it spirals is briefly mentioned. It is pointed out that the spiralling particles are trapped between two reflecting levels, the lower level being the magnetic mirror, and the upper one being the top distance which a spiralling particle can obtain in a gravity field. N.E.N.

N67-24432# Hahn-Meitner-Institut fur Kernforschung, Berlin (West Germany).

THE IONIZED RADIATION IN SPACE [DIE IONISIERENDE STRAHLUNG IM WELTRAUM]

W. Jacobi *In* Arbeitsgruppe Biophys. Raumforsch. Extraterrest. Biophys. and Biol. [1966] p 51–58 refs (See N67-24424 12-04)

The outer radiation field in space is formed by: (1) continuous transmission of galactic cosmic rays into our solar system; (2) solar fluxes emitted by gaseous turbulences in the sun's chromosphere; (3) the radiation belt of captured protons and electrons around our earth; and (4) the low energy radiation continually emitted from our sun and the cause of interplanetary plasma and solar winds. All radiations consist of electrically charged particles and their distributions are subject to magnetic influences from the sun or the earth. Transl. by G.G.

N67-24433# Medizinischen Akademie, Luebeck (West Germany). Institut fuer Strahlenforschung.

MEASUREMENT OF IONIZED RADIATION WITH SEMICONDUCTOR COUNTERS IN SPACE [MESSUNG IONISIERENDER STRAHLUNG MIT HALBLEITERZAEHLERN IM WELTRAUM]

J. M. Fox *In* Arbeitsgruppe Biophys. Raumforsch. Extraterrest. Biophys. and Biol. [1966] p 69–73 ref (See N67-24424 12-04)

Space radiation measurements by silicon gold-surface semiconductors for alpha count, and lithium drifted semiconductor detectors for beta and gamma observation is depicted. These diffusion semiconductors are suitable for satellite experiments because they combine minimal weight with remarkable insensitivity against acceleration and shock, work accurately between −200°C and +200°C, and display good performance in a vacuum. Included is the diagram of a Telstar satellite proton detector. Transl. by G.G.

N67-24447# Deutscher Wetterdienst, Offenbach am Main (West Germany).

ON THE SPECTRAL DIFFUSION OF SOLAR RADIATION IN SPACE [UEBER DIE SPEKTRALE VERTEILUNG DER SONNENSTRAHLUNG IM WELTRAUM]

Rudolf Schulze *In* Arbeitsgruppe Biophys. Raumforsch. Extraterrest. Biophys. and Biol. [1966] p 159–161 refs (See N67-24424 12-04)

Preliminary work on the creation of a laboratory solar radiation simulator resulted in a collection of rocket and satellite data on the spectral distribution of solar radiation in the ultraviolet. Procentual evaluation of short and longwave values established the solar radiation constant near earth at $I_0 = (1{,}39 \pm 0{,}04)$ kW/m^2. Transl. by G.G.

N67-24453# European Space Research Organization, Paris (France).

RADIATIONS IN SPACE

P. Auger *In its* Spacecraft Technol., Vol. 1 Oct. 1966 6 p (See N67-24451 12-31)

The following methods are advocated for measuring the different types of radiation in space: satellite-based instrumentation for detection of X- and gamma radiations or even moon-based instrumentation; and underground neutrino readings with astronomical instrumentation pointed toward the centrum of the earth. G.G.

N67-24464# Utrecht State Univ. (Netherlands).

X-RAY FLARES

C. de Jager *In* ESRO Proj. ELOISE: Proposal for a European Large Orbiting Instr. for Solar Expt. Aug. 1966 p 15–19 refs (See N67-24461 12-31)

The X-ray flare is defined and briefly compared with the optical flare. Bursts from X-ray flares are classed according to their production mechanisms into quasi-thermal X-ray events and nonthermal X-ray bursts. The flare associated hard X-ray bursts may be divided, according to their appearance and to the associated radio and optical phenomena, into two classes which may be further sub-divided: nonimpulsive X-ray bursts, and impulsive and short-lived X-ray bursts. The latter bursts may be further sub-divided into three groups according to related radio events. Some classical examples of X-ray bursts are given and theoretical and observational problems are discussed. R.N.A.

N67-24465# Utrecht State Univ. (Netherlands).

CHROMOSPHERIC PROBLEMS AND THEIR INVESTIGATION WITH A LARGE ASTRONOMICAL SATELLITE

M. Minnaert *In* ESRO Proj. ELOISE: Proposal for a European Large Orbiting Instr. for Solar Expt. Aug. 1966 p 21–29 (See N67-24461 12-31)

Several essential problems in the chromosphere which need to be solved are outlined. These problems involve the occurrence of spicules at lower levels and the total area fraction they occupy at each height, temperature and electron variation with height in the spicules and the interspicular region, whether abundances are the same in the chromosphere and lower corona as in the photosphere, and the difference between the chromospheric structure above normal regions and above plages. The discussion shows that these problems can be studied by satellite observations of the EUV spectrum on the disc, the EUV spectrum of the solar limb, and the continuum outside the limb. Calibration and standardization are essential in all three of these spectral observations. The spectral observations of localized points on the sun should be complemented by spectroheliograms or filtergrams in different EUV spectral lines, and combined with simultaneous ground observations. Consideration should also be given to solar flux measurements in wavelengths between 0.01 and 1 mm. R.N.A.

N67-24466# Observatoire du Pic-du-Midi (France).
PHOTOSPHERIC PROBLEMS [PROBLEMES PHOTOSPHERIQUES]
J. Roesch *In* ESRO Proj. ELOISE: Proposal for a European Large Orbiting Instr. for Solar Expt. Aug. 1966 p 31–37 In FRENCH (See N67-24461 12-31)

Organizational details of ELOISE (European Large Orbiting Instrumentation for Solar Experiments) Project are outlined in relation to instrumental photospheric observations. The feasibility and requirements of the observational satellite are briefly discussed. Transl. by R.LI.

N67-24708# Air Force Cambridge Research Labs., Bedford, Mass.
COMPUTED ELECTRON, ION, AND NEUTRAL DENSITY PROFILES FOR THE SOLAR ECLIPSE OF 12 NOVEMBER 1966
T. J. Keneshea (Industrial Nucleonics Corp.) and R. J. Fowler Oct. 1966 33 p refs *Its* Environ. Res. Papers no. 233
(AFCRL-66-741; AD-646975) CFSTI: HC $3.00/MF $0.65

A general computer model of the ionospheric behavior during a solar eclipse is briefly described. Solutions are generated for 15 ionospheric species during the solar eclipse of 12 November 1966. These solutions are for altitudes from 60 to 120 kilometers, and include both neutral and charged species. Author (TAB)

N67-24752# Michigan Univ., Ann Arbor. Dept. of Astronomy.
BASIC SOLAR RESEARCH Annual Report, Oct. 1, 1965–Oct. 1, 1966
O. C. Mohler 1 Oct. 1966 7 p refs
(Contract Nonr-1224(19))
(AD-646372) CFSTI: HC $3.00/MF $0.65

The staff of the McMath-Hulbert Observatory engaged in a number of studies concerned with solar activity, solar flares, solar-terrestrial relationships, solar spectroscopy, and applications of hydromagnetic theory to the sun. TAB

N67-24835# Air Force Systems Command, Kirtland AFB, N. Mex. Air Force Weapons Lab.
EXPERIMENT D8: RADIATION IN SPACECRAFT
Marion F. Schneider, Joseph F. Janni, and B. Brentnall May 1966 272 p refs
(SSD-TR-66-115; AD-646555) CFSTI: HC $3.00/MF $0.65

This document describes in technical detail the Air Force Radiation Experiment D8, carried out as a part of the 631A Program on the NASA Gemini flights. This experiment was concerned with gathering dose data and developing techniques furthering the art of manned spacecraft radiation dosimetry systems. Information from D8 should be of significant value in insuring manned mission safety and success in the future. From this effort new and highly sophisticated space-flight-worthy radiac systems have evolved. Their versatility in manned space operations was demonstrated for the first time on Gemini IV. D8 was the initial effort to place a complete dosimetry system on-board a manned spacecraft. This radiation experiment consisted of the latest available passive devices complimentary to (and correlated with) active ionization chambers giving instantaneous dose data. The information gathered in this experiment has been used to perform vital empirical checks on existing computational techniques and is presently providing corrections for application to theoretical prediction capabilities for radiation hazards associated with future manned spaceflights. TAB

N67-24865# Colorado Univ., Boulder.
PHYSICS OF THE SOLAR CORONA Final Report, 1 Feb. 1966–31 Jan. 1967
Donald E. Billings Feb. 1967 6 p
(Grant Nonr(G)-00025-66)
(AD-647075) CFSTI: HC $3.00/MF $0.65

Activity under the contract included completion of a book "A Guide to the Solar Corona," arranging a symposium on the corona, studies of coronal temperature variation with sunspot cycle and with height, and short-time variations in temperature. Author (TAB)

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N67-23613# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
NATURAL FAMILIES OF PERIODIC ORBITS
Andre Deprit and Jacques Henrard Oct. 1966 56 p refs *Its* Mathematical Note No. 489
(D1-82-0574; AD-645478) CFSTI: HC $3.00/MF $0.65

In reference to any solution of a conservative dynamical system with two degrees of freedom, Hill's equation is generalized to encompass non-necessarily isoenergetic displacements as well as the isonergetic displacements caused by a variation of a parameter. This new variational equation is made the foundation of a methodical procedure for continuing numerically natural families of periodic orbits. The method consists of two steps—an isoenergetic corrector and a tangential predictor. Although the algorithm makes no assumption of symmetry on the periodic orbits to be continued, special attention is paid to the symmetric orbits, but only to show how in these cases the method can be simplified substantially. Author (TAB)

N67-23615# California Inst. of Tech., Pasadena. Owens Valley Radio Observatory.
POSITIONS FOR 3C REVISED RADIO SOURCES
E. B. Fomalont, J. D. Wyndham, and J. F. Bartlett 1966 17 p refs Submitted for publication *Its* Observations of the Owens Valley Radio Obs., No. 11
(Contract N00014-67-A0094-006)
(AD-645526) CFSTI: HC $3.00/MF $0.65

Positions for 275 radio sources, mainly from the 3C Revised Catalog, have been measured with the Owens Valley interferometer as part of a program to identify radio sources with optical objects. The observations were made at a frequency of 1421 MHz. Author (TAB)

N67-23816# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
NORMALIZATIONAL AT L_4
Andre Deprit, Jacques Henrard, and A. R. M. Rom Jul. 1966 24 p refs Presented at the Space Flight Mech. Specialist Conf., Denver, 6–8 Jul. 1966 Submitted for publication *Its* Mathematical Note No. 476
(D1-82-0556; AD-645513) CFSTI: HC $3.00/MF $0.65

Birkhoffs normalization about a stable equilibrium for a conservative Hamiltonian system with two degrees of freedom can be implemented in a direct way: the necessary canonical transformation is built up explicitly, without inversions, by the method of undetermined coefficients. This procedure has been programmed symbolically for an electronic computer. It has been applied up to order 13 to the equilateral center of libration in the Restricted Problem of Three Bodies for the system Earth-Moon. The validity of the normalization is discussed for this case. Author (TAB)

N67-23622# California Inst. of Tech., Pasadena. Owens Valley Radio Observatory.
A CATALOG OF THE EAST-WEST VISIBILITY FUNCTIONS OF RADIO SOURCES AT 1425 MHz
E. B. Fomalont 1967 73 p refs *Its* Vol. 1, No. 3
(Contract N00014-67-A-0094-0008)
(AD-645528) CFSTI: HC $3.00/MF $0.65

As part of a general program for determining the radio structure of discrete sources, 532 sources have been observed using the two 90-foot paraboloids at the Owens Valley Radio Observatory as an east-west interferometer. The frequency of the observations was 1425 MHz and up to nine east-west spacings, ranging from 144 wavelengths to 2626 wavelengths, were used. Author (TAB)

N67-23642*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SYSTEMS ANALYSIS
In its Supporting Res. and Advanced Develop. 28 Feb. 1967 p 1–32 refs (See N67-23641 12-11)

Theoretical and experimental papers presented under the general heading of systems analysis deal with a data compression method using polynomials, the first occurrence of specified sequences with first-order Markov processes, and new periodic orbits in the so-called elliptic restricted three-body problem. Implications of new values for the Mars mass and radius are reported, as is an estimate of unbraked impact time for a lunar landing mission. Improved determinations are given for the mass of Venus, and the Earth-Moon mass ratio, and Mariner II Doppler tracking data are reported. Tracking and time synchronization, data reduction, and short-period analysis are reported for a selenodesy experiment. M.W.R.

N67-23660*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LUNAR AND PLANETARY SCIENCES
R. H. Norton *In its* Supporting Res. and Advanced Develop. 28 Feb. 1967 p 293–305 refs (See N67-23641 12-11)

The Coudé facility for the Table Mountain Observatory 24-inch telescope is described, and observations are reported for the radio emission from Venus at 1.5 cm wavelength by using a tunable, narrow passband Dicke-type radiometer. For the latter, brightness temperatures of Venus cannot be determined from the autumn measurements because of effects from the Sun in the far sidelobes of the antenna and too-large antenna offsets during the observing cycle. The emission feature near 23.00 GHz for the spring data appears to be more pronounced relative to neighboring points as the illumination of the Venusian disk increases, and atmospheric extinction appears near the center of the water line. The effects of thermally nonuniform sources on the emission spectra of silicates are investigated to shed light on planetary petrology and mineralogy. M.W.R.

N67-23797*# Douglas Aircraft Co., Inc., Santa Monica, Calif.
LUNAR ORBIT MISSION ANALYSIS FOR THE IMPROVED DELTA LAUNCH VEHICLE AND AIMP-D SPACECRAFT
D. L. Mootchnik and J. Kork (Goddard Space Flight Center, Greenbelt, Md.) Washington, NASA, May 1967 27 p refs
(Contract NAS7-265)
(NASA-TN-D-3911) CFSTI: HC $3.00/MF $0.65 CSCL 22C

A detailed analysis was conducted for the AIMP-D spacecraft mission to determine the launch conditions and trajectory shaping which would maximize the probability of attaining a lunar orbit with a lifetime in excess of six months. This study arose from the relatively large transfer orbit injection errors which are associated with the spin stabilized solid propellant injection motor. No midcourse correction is available; the only control parameter is the time of firing of the fixed-impulse lunar orbit injection motor. The large errors resulted in analysis and solutions peculiar to this mission trajectory. It was found that for the applicable vehicle errors, maximum lunar orbit probability was obtained for a 72-hour flight time and a high injection flight path angle. A circular parking orbit could not be used because of the flight path angle requirement and the available launch times were thereby restricted. Analysis of the spacecraft and guidance constraints resulted in the selection of two launch periods, each of several days duration, occurring twice a year. Author

N67-23904* Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
REPORT ON THE DEVELOPMENT OF THE MANNED ORBITAL RESEARCH LABORATORY (MORL) SYSTEM UTILIZATION POTENTIAL. TASK AREA II: INTEGRATED MISSION DEVELOPMENT PLAN, BOOK 1
N. Kallay Oct. 1965 220 p refs
(Contract NAS1-3612)
(NASA-CR-66331; SM-48810, Bk. 1) CSCL 22A

The mission development plan for the MORL system consists of three plans. The Applications Plan and Projection Analyses are detailed planning projects in oceanography and meteorology to determine the potential man-hour requirements of orbital experiment programs performed in support of these two areas. The Systems Development Plan describes a recommended series of space systems to meet the requirements identified by the Applications Plan and the Projection Analyses. Emphasis is placed on defining a mission sequence for a second generation space station, the Apollo Applications Program/MORL interface, and the introduction of advanced logistics systems. The Experiment Plan consists of a set of experiments suggested as the experimental program for the initial 3 years of the MORL mission sequence that was evolved in the Systems Development Plan analyses. Experiments considered in formulating the Experiment Plan were taken from the experiment Data Bank collated from NASA and Air Force Studies, augmented by certain experiments selected from the Applications Plan analyses. These experiments were time scheduled and are subject to the six-man MORL performance capabilities. R.N.A.

N67-23909*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DIM LIGHT PHOTOGRAPHY AND VISUAL OBSERVATIONS OF SPACE PHENOMENA FROM MANNED SPACECRAFT, I
L. Dunkelman and R. D. Mercer Feb. 1966 19 p
(NASA-TM-X-55752; X-613-66-58) CFSTI: HC $3.00/MF $0.65 CSCL 22A

Information is presented which was given to the crews of Gemini VI and VII for use in the photography and visual observations of twilight, nighttime earth cloud cover, dark sky background, night airglow edge-on, zodiacal light and Gegenschein, aurorae, meteors, the Ikeya–Seki comet, lightning, galactic pole-to edge survey, and sunlit airglow. Also included are some general comments and notes on recommended techniques, and copies of the check lists used onboard both spacecraft. R.N.A.

N67-23910*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DETERMINATION OF SECOND AND FOURTH ORDER SECTORIAL HARMONICS IN EARTH'S GRAVITY FIELD FROM THE MOTION OF TWELVE-HOUR SATELLITES
James P. Murphy and Eric L. Victor Jan. 1967 21 p refs
(NASA-TM-X-55762; X-547-67-16) CFSTI: HC $3.00/MF $0.65 CSCL 22C

Values of the $\bar{C}_2^{(2)}$, $\bar{S}_2^{(2)}$, $\bar{C}_4^{(4)}$, and $\bar{S}_4^{(4)}$ sectorial harmonics in the earth's gravity field are obtained from the motion of two twelve-hour satellites. Each satellite was studied for a period in excess of two hundred days. Author

N67-23911# European Space Vehicle Launcher Development Organization, Paris (France).
ELDO TECHNICAL REVIEW, VOLUME I, NO. 4
[1966] 94 p in FRENCH and ENGLISH
CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. SELECTION CRITERIA OF RADIO-ISOTOPES FOR USE IN SPACE J. P. Contzen p 245–273 refs (See N67-23912 12-22)

2. INTRODUCTION TO SYNTHESIS OF RADIO GUIDANCE AND TRACKING STATIONS R. Cosaert p 275–333 refs (See N67-23913 12-07)

N67-23919*# TRW Systems, Redondo Beach, Calif.
COMPARISON OF THE JPL ODP-L AND TRW AT 85 ORBIT DETERMINATION PROGRAMS
[1967] 47 p
(Contract NAS1-4605-6)
(NASA-CR-66244) CFSTI: HC $3.00/MF $0.65 CSCL 22C

This report provides comparisons of computer runs made on the TRW-AT85 and JPL ODP-L programs. The runs compared are: 1) a nominal Lunar Orbiter trajectory in selenocentric and geocentric coordinates, and range and range rate data for visible stations computed from the trajectory; 2) normal matrices generated at one-half orbit and one orbit for 28 variables; and 3) a four iteration differential correction using previously developed observations in combination with the two programs. The 28-variable solution vector includes the state of Lunar Orbiter, lunar gravitational constant, and lunar potential coefficients through degree four. Author

N67-23928# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
ESTIMATES OF THE ZONAL GRAVITY HARMONICS OF THE MOON
T. A. Bray, C. L. Goudas, and Zdenka Kopal Dec. 1966 20 p refs *Its* Mathematical Note No. 495
(D1-82-0588; AD-645549) CFSTI: HC $3.00/MF $0.65

The best figure data of the Moon are treated in order to obtain estimates of the zonal gravity harmonics up to order eight. An analysis of the first tracking data of Lunar Orbiter 1 indicated that the second, third and fourth zonal harmonics compare favorably with the values obtained on the basis of the figure, but there is no clue as to the reliability of the zonal harmonics given here of order higher than the fourth. Author (TAB)

N67-23998# Max-Planck-Institut für Aeronomie, Lindau über Northeim (West Germany).
DETERMINATION OF IMPORTANT SATELLITE POSITIONS USING GRAPHIC REPRESENTATIONS [BESTIMMUNG WICHTIGER SATELLITENPOSITIONEN MIT HILFE GRAPHISCHER DARSTELLUNGEN]
Gerd Hartmann 1965 26 p refs In GERMAN; ENGLISH summary
(Rept.-19) CFSTI: HC $3.00/MF $0.65

A graphic method is presented for the efficient conversion of geocentric coordinates to topocentric coordinates. The method permits the precise determination of azimuth, angle of elevation, sight distance, and observation times of satellites. Included is an IBM 7040 computer program for calculating the function values of the graphic representation for any given observer location. The method is being used in monitoring radio signals from satellites. Transl. by K.W.

N67-24025 Royal Greenwich Observatory, Herstmonceux (England).
ANALYSIS OF THE COOL HALO SUBDWARF HD 25329
B. E. J. Pagel and A. L. T. Powell London, HMSO, 1966 25 p refs *Its* Bull. 124
HMSO: 3s 6d

The cool halo subdwarf HD 25329 was analyzed by a differential curve-of-growth technique relative to the sun. Apart from Mn and perhaps N, all elements studied (C, Na, Mg, Ca, Sc, Ti, V, Cr, Fe, Co, Ni, Sr, Ba, Ce and Eu) are found to be underabundant by a factor of about 20. Compared with the other elements, N may be overabundant, and Mn is almost certainly underabundant, in each case by a factor of about 3. The degree of metal deficiency is considerably smaller than that resulting from a previous analysis. The similarity of the heavy-element mixture to that found in stars of the galactic disk lends support to Dixon's hypothesis that the galaxy was well mixed during its initial phase, and leads furthermore to the conclusion that most of the elements from carbon upwards were built in objects having masses at least ten times that of the sun. The significance of the commonly observed manganese anomaly is discussed. Author

N67-24026 Royal Greenwich Observatory, Herstmonceux (England).
COLOURS, LUMINOSITIES AND MOTIONS OF THE NEARER GIANTS OF TYPES K AND M
Olin J. Eggen London, HMSO, 1966 68 p refs *Its* Bull. 125
HMSO: 9s

Tables are presented giving the available colors, luminosities, and motions of 1008 giants of types K and M, brighter than visual magnitude 5.5. Author

N67-24040# Copenhagen Observatory (Denmark).
THE RADIAL VELOCITY OF δ CETI
Henning Elo Jorgensen 1966 17 p refs
(Publ.-187) CFSTI: HC $3.00/MF $0.65

The radial velocity of δ Ceti has been derived from 77 spectrograms obtained in 1953. The velocity curve agrees with earlier determinations except for a small phase difference, which is caused mainly by differential line velocities. Some unidentified lines are common to δ Ceti and γ Peg, which is another β Cephei star of the same spectral type and luminosity class as δ Ceti. Author

N67-24199# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
THE INTERACTION OF A RETRO-ROCKET EXHAUST PLUME WITH THE MARTIAN ENVIRONMENT
K. M. Foreman Feb. 1967 50 p refs
(RM-354) CFSTI: HC $3.00/MF $0.65

A simplified model preliminary analysis is made of the flow field from a Mars landing rocket. At high altitude, during full thrust output, the hot axisymmetric near field extends only about 10 feet in diameter, whereas the cooler far field can spread to a 40-foot diameter at 200 to 500 feet axially downstream. The latter boundaries are greatly influenced by planetary winds. Near the Martian surface, at incipient shutdown, the high temperature ground jet is capable of eroding low cohesion surface material, within a 50-foot radius, and of producing transient thermal

abnormalities within a 40-foot diameter area of the surface under the rocket. For the assumed model conditions, it is concluded that the landing rocket's interactions with the natural environment are of limited spatial extent, within predictable magnitudes, and likely to be nonrestrictive to scientific and engineering objectives of the mission. The retrorocket terminal landing system appears to warrant serious consideration. Author

N67-24229# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
DETERMINATION OF THE BRIGHTNESS OF THE ATMOSPHERE OF THE PLANET MARS
A. Dollfus Jul. 1966 13 p refs Transl. into ENGLISH from Compt. Rend. Soc. (Paris), v. 262, ser. B, 14 Feb. 1966 p 519–522
(TR-34) CFSTI: HC $3.00/MF $0.65

The measurements of the variation of polarization of light of the planet Mars between the center and the edge of its disk gives the brightness of the atmosphere, in the absence of haze or clouds, as 6×10^{-4} sb/phot. If the air is devoid of aerosols, the pressure at the surface should be 30 mb. Author

N67-24268*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
PROCEEDINGS OF THE INTERDISCIPLINARY SYMPOSIUM ON APOLLO APPLICATION PROGRAMS, 12–13 JANUARY 1966
Dec. 1966 284 p refs Symp. held at NASA. Marshall Space Flight Center, 12–13 Jan. 1966
(NASA-TM-X-53558) CFSTI: HC $3.00 CSCL 22A

CONTENTS:

1. SOME PROBLEMS IN DESIGNING A LUNAR PHOTOGRAPHIC SURVEY MISSION W. L. Austin and J. L. Harden (GE) p 5–20 (See N67-24269 12-30)

2. LUNAR TERRAIN ANALYSIS R. L. Sanders and W. M. Greene (Hayes Intern. Corp.) p 21–38 (See N67-24270 12-30)

3. A DISCUSSION OF PROPOSED LANDING SITES FOR AAP LUNAR MISSIONS J. R. Rogers (Brown Eng. Co.) p 39–60 refs (See N67-24271 12-30)

4. DEVELOPMENT OF A LUNAR PHOTOMETRIC FUNCTION FROM EXPERIMENTAL DATA E. F. Snyder (Chrysler Corp.) p 61–116 refs (See N67-24272 12-30)

5. ANALYSIS AND CORRELATION OF THERMODYNAMIC CYCLES FOR SPACE APPLICATIONS D. M. Adams (Thiokol Chem. Corp.) p 117–142 refs (See N67-24273 12-33)

6. MATHEMATICAL ADVANCES IN THE THEORY OF ONE DIMENSIONAL FLOW E. Y. Rodin (Wyle Labs.) p 143–160 refs (See N67-24274 12-12)

7. LOW FREQUENCY RADIO ASTRONOMY IN SPACE N. F. Six (Brown Eng. Co.), G. R. Lebo, and A. G. Smith (Fla. Univ.) p 161–189 refs (See N67-24275 12-30)

8. REMOTE SENSING WITH OPTICAL CROSS-CORRELATION METHODS F. R. Krause (Aero-Astrodyn. Lab.) and M. J. Fisher (IIT Res. Inst.) p 191–214 refs (See N67-24276 12-14)

9. SOME CONCEPTS FOR AN EMPLACED SCIENTIFIC STATION ON THE LUNAR SURFACE R. D. Shelton p 215–227 refs (See N67-24277 12-30)

10. SIMULATED WEIGHTLESSNESS UNDER NEUTRAL BUOYANCY R. D. Dean and R. P. Langan (Boeing Co.) p 229–240 refs (See N67-24278 12-11)

11. DEVELOPMENT OF A DEVICE FOR PHYSICAL CONDITIONING DURING WEIGHTLESSNESS G. Chase, C. Grave, J. Goode, and G. Graham (Boeing Co.) p 241–248 refs (See N67-24279 12-05)

12. HYPERSONIC NONEQUILIBRIUM FLOW AT RE-ENTRY OF SPACE VEHICLES AND ITS THERMODYNAMIC RELATIONS R. Hermann (Ala. Univ. Res. Inst.) p 249–270 refs (See N67-24280 12-30)

N67-24269*# General Electric Co., Daytona Beach, Fla.
SOME PROBLEMS IN DESIGNING A LUNAR PHOTOGRAPHIC SURVEY MISSION
W. L. Austin and J. L. Harden *In* NASA. Marshall Space Flight Center Proc. of the Interdisciplinary Symp. on Apollo Appl. Programs, 12–13 Jan. 1966 Dec. 1966 p 5–20 (See N67-24268 12-30)

Problems associated with the design of a lunar photographic survey mission, specifically the translunar trajectory and preferred lighting ring, are discussed. The preferred lighting ring is discussed in general terms in order to show its characteristics over a 28-day lunar orbit. A 28-day orbit duration is desirable, since regardless of the polar-orbit altitude, the entire surface would rotate under the spacecraft in 27.32 days. The trajectories are discussed for a particular day in a particular synodic month, and are not to be considered as general results. It is a general result, however, that once an arrival longitude and sun angle are specified, there is at best one launch window in any given synodic month. In order to open up this launch window, it would be necessary to vary the boundary conditions at lunar orbit insertion. Author

N67-24270# Hayes International Corp., Birmingham, Ala.
LUNAR TERRAIN ANALYSIS
R. L. Sanders and W. M. Greene *In* NASA. Marshall Space Flight Center Proc. of the Interdisciplinary Symp. on Apollo Appl. Programs, 12–13 Jan. 1966 Dec. 1966 p 21–38 (See N67-24268 12-30)

The distribution of lunar topographic and geologic features of scientific interest was analyzed in order to assess surface mobility requirements for early lunar exploration missions. The study provided an analysis of lunar geology and geologic age classification. Classified, reviewed and analyzed, were Aeronautical Chart and Information Center (ACIC–LAC) charts and United States Geological Survey (USGS) maps. A presentation of singular lunar sites of special interest was made, and a study of the Apollo Landing Belt was effected. Author

N67-24271*# Brown Engineering Co., Inc., Huntsville, Ala.
A DISCUSSION OF PROPOSED LANDING SITES FOR AAP LUNAR MISSIONS
John R. Rogers *In* NASA. Marshall Space Flight Center Proc. of the Interdisciplinary Symp. on Apollo Appl. Programs, 12–13 Jan. 1966 Dec. 1966 p 39–60 refs (See N67-24268 12-30)

The following five sites on the lunar surface have been recommended for AAP missions: Hyginus Crater and Rill, Floor of the Crater Alphonsus, Hadley's Rill Region, Censorinus C, and Moltke B. Presented is a discussion of the scientific reasons for selecting each site and information on the nature of geological problems which might be investigated. A possible traverse around Site 2 (Floor of Alphonsus) is outlined. Recommendations for the planning of surface missions are made, based on new detailed information available from Ranger photographs. Author

N67-24272*# Chrysler Corp., New Orleans, La.
DEVELOPMENT OF A LUNAR PHOTOMETRIC FUNCTION FROM EXPERIMENTAL DATA
E. F. Snyder *In* NASA. Marshall Space Flight Center Proc. of the Interdisciplinary Symp. on Apollo Appl. Programs, 12–13 Jan. 1966 Dec. 1966 p 61–116 refs (See N67-24268 12-30)

The need exists for an accurate photometric model of the lunar surface's directional reflection characteristic under all angles of solar illumination. Using an empirical approach and some mathematical theory, a functional expression is developed to describe the existing lunar directional reflectance characteristics. A two-dimensional equatorial photometric function is developed initially, and is expanded into a three-dimensional photometric function. For ten widely distributed lunar craters, and for the entire range of phase angles, very good agreement is demonstrated between the

experimental results and the predicted results using the developed lunar photometric function. The developed three-dimensional lunar photometric function has been integrated over the face of the moon for many phase angles. The integrated brightness at phase angle using the developed photometric function is in excellent agreement with experimental results of Rougier and other investigators. Author

N67-24275*# Brown Engineering Co., Inc., Huntsville, Ala.
LOW FREQUENCY RADIO ASTRONOMY IN SPACE
N. F. Six, G. R. Lebo, and A. G. Smith (Florida Univ.) *In* NASA. Marshall Space Flight Center Proc. of the Interdisciplinary Symp. on Apollo Appl. Programs, 12–13 Jan. 1966 Dec. 1966 p 161–189 refs (See N67-24268 12-30)

Radio astronomical observations made from the surface of the Earth are restricted at the high frequency end of the RF spectrum by the troposphere and at the low frequency end by the ionosphere. Artificial Earth satellites provide the means for eliminating these restrictions, but low frequency studies require large antennas, so a large stable platform is desirable. The surface of the Moon meets this requirement. In order to study the sources (Sun, Jupiter, radio stars, cosmic background, and perhaps Earth and Saturn) over the frequency range from 30 kHz to 10 MHz, the radiometer should be able to measure intensity, apparent position, apparent size, temporal variation, and polarization. The order of experiments will most likely be determined by the antenna system complexity and size. Early experiments on the lunar surface probably will employ simple broadband "pencil-beam" antennas. Man will be necessary for antenna installation and initial calibration. Author

N67-24277*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SOME CONCEPTS FOR AN EMPLACED SCIENTIFIC STATION ON THE LUNAR SURFACE
Russell D. Shelton *In its* Proc. of the Interdisciplinary Symp. on Apollo Appl. Programs, 12–13 Jan. 1966 Dec. 1966 p 215–227 refs (See N67-24268 12-30)

Reported are results of a joint study effort to develop a concept for an emplaced scientific station (ESS) for : (1) acquiring data on the lunar interior by means of seismic detectors and probe measurements; (2) monitoring the lunar atmosphere; (3) measuring fluxes of nuclear and meteoroid particles; and (4) studying the moon as a possible base for improved planetary and stellar astronomy. Physical requirements (storage and packaging), design criteria, and power sources for the ESS are discussed; and instrumentation requirements for lunar surface radiation experiments, studies of lunar body motions, and astronomical studies are reviewed. S.C.W.

N67-24280*# Alabama Univ. Research Inst., Huntsville.
HYPERSONIC NONEQUILIBRIUM FLOW AT RE-ENTRY OF SPACE VEHICLES AND ITS THERMODYNAMIC RELATIONS
Rudolf Hermann *In* NASA. Marshall Space Flight Center Proc. of the Interdisciplinary Symp. on Apollo Appl. Programs, 12–13 Jan. 1966 Dec. 1966 p 249–270 refs (See N67-24268 12-30) (Grant NsG-381)

Analytical studies of hypersonic nonequilibrium flow around blunt bodies are reported. Flight regions and equilibrium values of flow parameters behind the normal shock of a space vehicle, such as the Apollo capsule, reentering the Earth's atmosphere are presented; and basic features of equilibrium, nonequilibrium, and frozen flow are discussed. Real gas effects are treated using a simplified air model. With restriction to oxygen dissociation only, the thermal equation of state, the thermodynamic expressions of energy and enthalpy, and the rate equation for the net production of oxygen atoms are shown. Hypersonic inviscid flow about the forward portions of cylinders up to the equator was numerically calculated in the range of oxygen dissociation, using the direct one-strip integral method of Dorodnitsyn. Studies include the influence of the absolute body size and the effects of the free stream dissociation on the shock detachment distance and the flow field. Author

N67-24441# Bern Univ. (Switzerland).
ON THE CONFIRMATION OF ORGANIC MATERIALS ON MARS [ZUR FESTSTELLUNG ORGANISCHEN MATERIALS AUF DEM MARS]
J. Eugster *In* Arbeitsgruppe Biophys. Raumforsch. Extraterrest. Biophys. and Biol. [1966] p 123–125 (See N67-24424 12-31)

Described is a bell-shaped sonde with a thin wire mesh across its opening that will ignite upon landing on Mars surface and burn up the organic material it contacts. It will contain batteries to provide ignition power. Transparent tubes in its interior catch the developing gaseous fumes and are analyzed by spectrophotometer; a telemetry system transmits the spectrum to the Earth ground station. Transl. by G.G.

N67-24454# European Space Research Organization, Paris (France).
SPACE SCIENCE AND TECHNOLOGY. THE ESRO PROGRAMME
A. W. Lines *In its* Spacecraft Technol., Vol. 1 Oct. 1966 11 p (See N67-24451 12-31)

The ESRO space science and technology program includes a number of sounding rocket launchings; during the first year about 12, the year after that about 40, and then going up to about 50 sounding rockets per year. Secondly, small ESRO satellites will be launched for observing ionospheric and auroral phenomena. Thirdly, a large astronomical satellite is projected carrying an ultra-violet spectroscope with a resolution of better than 1 Å. The fourth item is a medium size satellite for as yet undetermined scientific application, that will be launched by a Thor Delta and will be stabilized in some way. G.G.

N67-24458# Royal Aircraft Establishment, Farnborough (England).
SPACECRAFT ORBITS
G. F. Cook *In* ESRO Spacecraft Technol., Vol. 1 Oct. 1966 42 p refs (See N67-24451 12-31)

The theory for the motion of a particle subject to a central inverse square law of attraction is reviewed, and the equations pertaining to it are derived. It is pointed out that in preliminary studies of space trajectories, approximate results can be obtained by reducing the problem to a succession of two-body problems. A space vehicle in the Earth–Moon system is considered, and the concept of spheres of influence is used in order to apply the two-body integrals. The motion of the vehicle is treated as if it were under the influence of either the earth or the moon. Lunar trajectories, lunar satellites, interplanetary trajectories, and the orbit in space are examined. The basic equations of perturbed motion are discussed, and the vector constants which can be used to define an unperturbed orbit are derived. Osculating elements and their rates of change are mathematically described. Equations are formulated to define the effect of the earth's gravitational potential on a satellite orbit, the contraction of a satellite orbit under the influence of air drag, and the luni-solar perturbations of earth satellites. M.G.J.

N67-24463# Observatoire de Paris (France).
OPTICAL OBSERVATION OF SOLAR ERUPTIONS WITH A LARGE SATELLITE [OBSERVATION OPTIQUE DES ERUPTIONS SOLAIRES AVEC UN GRAND SATELLITE]
R. Michard *In* ESRO Proj. ELOISE: Proposal for a European Large Orbiting Instr. for Solar Expt. Aug. 1966 p 9–13 In FRENCH (See N67-24461 12-31)

Summary observations are presented on optical considerations of solar eruptions in the far ultraviolet region. The need is cited of organizing observation programs of solar eruptions in the visible spectrum, in conjunction with the ELOISE (European Large Orbiting Instrumentation for Solar Experiments) Project in the ultraviolet, in order to compare the Balmer spectrum with the Lyman spectrum. Transl. by R.Li.

N67-24469# Fraunhofer Institut, Freiburg (West Germany).
PROJECT "SPECTRO-STRATOSCOPE"
J. P. Mehltretter *In* ESRO Proj. ELOISE: Proposal for a European Large Orbiting Instr. for Solar Expt. Aug. 1966 p 57–62 (See N67-24461 12-31)

Project SPECTRO-STRATOSCOPE is a.. automatically guided remote controlled balloon borne solar observatory. The project intends to take advantage of the absence of atmospheric image degradation at heights of around 20 km in the stratosphere to obtain time sequences of simultaneous pictures and spectra of photospheric and chromospheric find structure, with high spectroscopic and diffraction limited spatial resolution. Brief descriptions are given of the observatory's optical equipment, mechanical structure, stabilization and guidance system, automatic focusing device, telemetry, and remote control system. R.N.A.

N67-24470# European Space Technology Center, Delft (Netherlands).
TELEMEASURE PROBLEMS CONCERNING A SOLAR OBSERVATION SATELLITE (PROJECT "ELOISE") [PROBLEMES DE TELEMESURE CONCERNANT UN SATELLITE D'OBSERVATIONS SOLAIRES (PROJET "ELOISE")]
Pierre Blassel *In* ESRO Proj. ELOISE: Proposal for a European Large Orbiting Instr. for Solar Expt. Aug. 1966 p 63–73 In FRENCH (See N67-24461 12-31)

The satellite telemetry problems for the ELOISE (European Large Orbiting Instrumentation for Solar Experiments) Project are very briefly discussed. The transmission, reception and data collection requirements are presented. The preparation of on-board telemetry equipment for solar observations from a satellite is also reported. Transl. by R.Li.

N67-24635*# National Aeronautics and Space Administration, Washington, D. C.
SPACECRAFT FIND LIMITS OF SHELL PROTECTING EARTH
18 Apr. 1967 14 p refs
(NASA News Release-67-94) Available from the Scientific and Technical Information Division CSCL 22A

Summary information is presented on the more important preliminary results obtained from the Pioneer VI and VII interplanetary spacecraft. It is pointed out that the scientific information returned to earth includes data on the limits of the earth's protective magnetic envelope, the magnetosphere, which ends at approximately 3.5 million miles; measurements of the earth's bow shock wave; solar wind temperature; interplanetary electron temperatures; solar induced cosmic radiation; and the interplanetary magnetic field. M.G.J.

N67-24730# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ESTIMATES OF THE REMAINDERS OF HILL'S SERIES
M. S. Petrovskaya 30 Sep. 1966 28 p refs Transl. into ENGLISH from Byul. Inst. Teor. Astron. (USSR), v. 9, no. 4, 1963 p 257–273
(FTD-HT-66-241; TT-67-60787; AD-646449) CFSTI: HC $3.00/MF $0.65

Estimates of the remainders in Hills series are obtained for cases where the coefficients in these series which are series in powers of m = n sub 0/(n sub 1-n sub 0)(where n sub 0 and n sub 1 are the mean angular velocities of the sun and the moon), are computed with accuracy to the 2nd, 3rd, 4th, 5th, and 6th powers of m. New estimates are also obtained for the remainders of Hills series expanded in powers of m to the 2nd, which were examined in Lyapunovs paper (1954). The estimates are obtained for the case of m < o = sigma (approx. 0.080849), where sigma is the value of the parameter m for the moon. TAB

N67-24804# Lowell Observatory, Flagstaff, Ariz.
THE SUN AS A VARIABLE STAR III Final Report, 1950–1966
M. Jerzykiewicz and K. Serkowski Jan. 1967 32 p refs /ts Bull. 137
(Contract AF 19(628)-3809)
(AFCRL-66-792; AD-646446) CFSTI: HC $3.00/MF $0.65

The observations of Neptune in the years 1950-1962, corrected for the effects of changing distance, indicate a decrease in blue magnitude from 8.26 to 8.23. During the period 1963-1966 the brightness was constant and equal to 8.24 mag. The steady decrease of the instrumental transformation coeffcient A8 in the years 1950-1960 throws some doubt on the reality of the changes in Neptunes brightness. If these changes are real they may be due either to intrinsic changes in Neptunes surface or to solar variability or to both. The observations of Uranus indicate no changes in solar brightness from 1950 to 1966 if 22 percent darkening from the equator towards the pole of the planet is assumed. On this assumption the total range of the intrinsic change of the blue magnitude of Uranus is 0.038 mag., with a period of 42 years. In the authors opinion, this long sequence of photoelectric observations has taught us more about the variations of solar type stars than about the sun itself. The observations of 15 stars of spectral types F and G in the years 1955-1966 indicate that for none of these stars does the standard deviation of the yearly mean magnitude exceed 0.008, and for the stars 40 Leo, beta CVn and eta Boo this deviation is less than 0.004 mag. No evidence of variability in the stars which are similar to the sun has been detected during this program. If we assume the sun acts in similar fashion to each of these stars, its variability over a fifteen-year period probably does not exceed one-half of one percent. Another by-product of this research results from one of the most extensive series of night-time extinction observations ever carried out at a single observatory. Author (TAB)

N67-24913# RAND Corp., Santa Monica, Calif.
PRELAUNCH CHECKOUT IN THE 1970s
L. T. Mast Jan. 1967 10 p refs
(P-3518; AD-646600) CFSTI: HC $3.00/MF $0.65

The paper attempts to predict the prelaunch environment of space launches in the 1970s. The author projects the major changes likely to occur in vehicle subsystems, prelaunch requirements, and launch site technology from those we know today, and attempts to create a picture of that future launch environment. TAB

N67-25026* International Information, Inc., Philadelphia, Pa.
METEORITICS
V. G. Fesenkov and Ye. L. Krinov Washington, NASA, Nov. 1966 183 p refs Transl. into ENGLISH from Meteoritika (Moscow), no. 20, 1961 Proc. of the 9th Conf. on Meteorites, Kiev, 2–4 Jun. 1960
(Contract NASw-1499)
(NASA-TT-F-10403) CSCL 03B

The principle task of the conference was the discussion of studies on the Tunguska meteorite. Results of research institute investigations are presented and important problems involving future research projects are considered. It is emphasized the further study of the Tunguska meteorite region is needed. Topics covered include: meteorite study trends, soil sample mineralogy, atmospheric phenomena, meteoric body aerodynamics, thermal explosions, and meteorite parameter estimations. A.G.O.

N67-25039*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
PHOTOMETRY OF SPECTROGRAMS OF THREE ARTIFICIAL METEORS
Gale A. Harvey Washington, NASA, May 1967 33 p refs
(NASA-TN-D-3930) CFSTI: HC $3.00/MF $0.65 CSCL 03A

Absolute spectral photometry has been performed on spectrograms of three artificial meteors. The meteors were a −3 magnitude, 10 km/s, 1.5-gram, iron dust-ball meteor at 48 kilometers' altitude; a −3 magnitude, 10.7 km/s, 1.5-gram iron dust-ball meteor at 68 kilometers' altitude; and a −1 magnitude, 9.5 km/s, 0.6-gram, solid iron meteor at 60 kilometers' altitude. Post-factum calibrations were used for most of the photometry. The measurements are initial quantitative spectral data for meteors of known mass and composition and constitute initial quantitative meteoric spectral data in the near-ultraviolet region. The radiation recorded was atomic radiation from excited atoms of the artificial meteoroid material, and significant energies were associated with the iron meteoric radiation in the near-ultraviolet region. Author

N67-25042*# National Aeronautics and Space Administration, Manned Spacecraft Center, Houston, Tex.
VENUS AND MARS NOMINAL NATURAL ENVIRONMENT FOR ADVANCED MANNED PLANETARY MISSION PROGRAMS
Dallas E. Evans, David E. Pitts, and Gary L. Kraus Washington, NASA, 1967 59 p refs Revised
(NASA-SP-3016) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Numerical values are established for a nominal natural environment for application in studies on advanced manned planetary missions to Venus and Mars. The data are compiled to provide a standard environment so that various mission and preliminary design studies can be based on realistic data and have a common basis for comparison of end results. The data for the natural environment have been broken into several sections to account for a wide variety of environmental factors which may be needed. Appropriate references are given for the various literature sources from which the information was obtained. Author

N67-25043*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
TRAJECTORY OPTIMIZATION FOR AN APOLLO-TYPE VEHICLE UNDER ENTRY CONDITIONS ENCOUNTERED DURING LUNAR RETURN
John W. Young and Robert E. Smith, Jr. Washington, NASA, May 1967 41 p refs
(NASA-TR-R-258) CFSTI: HC $3.00/MF $0.65 CSCL 22C

Details are given on a numerical optimization study conducted to investigate optimal performance boundaries, from considerations of maneuver capability and entry heating, for an Apollo-type vehicle under entry conditions encountered during lunar return. Results presented show the effects on these performance boundaries of variations in initial entry conditions and vehicle characteristics and of constraints on such trajectory variables as altitude and acceleration. The effect of the earth's rotation on optimal performance is also included. Typical trajectories are presented to illustrate and contrast the basic nature of various optimal entry missions. The results show that there are numerous trade-offs possible between maximum maneuver capability and optimal entry heating. The determining factors for these trade-offs are the initial entry conditions, the trajectory constraints, and the physical characteristics of the entry vehicle. Although radiative effects can account for a significant portion of total entry heating, the trajectories for optimal heat entries are largely determined by convective inputs. Author

N67-25068*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
OPERATIONS PROGRAMMING
In its Space Programs Sum. No. 37-44, Vol. III 31 Mar. 1967 p 128-131 refs (See N67-25061 12-07)

The completion and testing of the mission dependent programming task for the Surveyor project are reported, and improvements in telemetry data recovery methods for the application of advanced programming techniques to flight operations are discussed. A method is described which combines the functions of frame synchronization and demodulation of phase shift keyed PCM telemetry data, and a digital computer program was written, utilizing a known pattern within the data stream which was intended for frame synchronization of the demodulated bit stream. N.E.N.

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N67-23835# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SPACE VEHICLE CONTROL
K. B. Alekseyev and G. G. Bebenin 13 Jul. 1966 355 p refs Transl. into ENGLISH of the book "Upravleniye Kosmicheskim Letatel'nym Apparatom" Moscow, Mashgiz, 1964 p 1-402
(FTD-MT-65-137; TT-67-60476; AD-645768) CFSTI: HC $3.00/MF $0.65

The book acquaints the reader with the basic principles of space vehicle control. It contains three sections which consider the basic properties of space vehicles as objects of control, describe the elements of control systems, and expound the principles of construction and investigation of such systems. Special attention is allotted to the theory of measurement of parameters of motion and control of the angular motions of space vehicles. In particular, questions of the application of gyroscopic devices and an infrared vertical for the construction of a base reference system on board a space vehicle are considered, and an investigation of spatial orientation of a vehicle with the help of flywheel engines is conducted. There appears the possibility of using the gravitational and magnetic fields of the Earth for purposes of control. Basic fundamental questions of controlling a space vehicles re-entry are briefly considered. Author (TAB)

N67-23880*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SURVEYOR II MISSION REPORT. MISSION DESCRIPTION AND PERFORMANCE
1 Apr. 1967 188 p refs
(Contract NAS7-100)
(NASA-CR-83644; JPL-TR-32-1086) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Surveyor II, the second of a series of unmanned missions designed to soft-land on the moon, was launched from Cape Kennedy, Florida, on September 20, 1966. After a nominal launch phase and accurate injection into lunar transfer trajectory, a normal transit phase was achieved until execution of midcourse velocity correction, when one of the three vernier engines failed to fire, causing unbalanced thrust. A spacecraft tumbling condition resulted which could not be corrected either by use of the cold-gas jet system or repeated firings of the vernier engines. The unstable condition caused premature termination of the mission and prevented attainment of the flight objectives, for which a soft-landing was prerequisite. A thorough investigation by a specially appointed Failure Review Board has not disclosed a specific cause for the failure. A technical description of the mission and an evaluation of engineering data obtained are presented herein. Author

N67-23915*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DEVELOPMENT OF THE FABRICATION AND PACKAGING TECHNIQUES FOR THE ECHO II SATELLITE
James P. Talentino Dec. 1966 169 p refs
(NASA-TM-X-55764; X-724-66-568) CFSTI: HC $3.00/MF $0.65 CSCL 22B

This document describes the techniques developed and used in processing the Echo II satellite from raw material to flight-ready hardware. The design concepts, fabrication and packaging techniques, improvements in techniques, and test methods are discussed. Author

N67-23960*# National Aeronautics and Space Administration, Washington, D. C.
PROJECT: LUNAR ORBITER D
2 May 1967 51 p
(NASA News Release-67-101) Available from the Scientific and Technical Information Division CSCL 22B

NASA information released on the occasion of the spacecraft launching is presented. Covered are: (1) background of Lunar Orbiter project; (2) spacecraft configurations, including camera, power, control, communications, and temperature control systems; (3) Lunar Orbiter tasks, including photography, selenodesy, meteoroid, and radiation measurements; (4) Atlas-Agena D launch vehicle; (5) data acquisition and evaluation by the Deep Space Network; (6) countdown, flight, and orbit injection sequences; and (7) Lunar Orbiter and Atlas-Agena personnel teams. K.W.

N67-23977*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
FURTHER DETERMINATIONS OF THE MAGNITUDE AND BRIGHTNESS FLUCTUATIONS OF THE PAGEOS SATELLITE
S. H. Genatt, J. E. Moye, E. G. Reid, and H. E. Walker Sep. 1966 26 p refs
(NASA-TM-X-55756; X-524-66-467) CFSTI: HC $3.00/MF $0.65 CSCL 22B

A passage of the Pageos satellite was observed electro-optically on July 13, 1966. The maximum brightness of Pageos reached during this pass was computed to be +1.7 magnitude and its periodic brightness fluctuations were determined to be 39 seconds. These values compare with +2.1 magnitude and 116 seconds period deduced from a passage on June 25, 1966. The observed reflecting qualities of Pageos are unlike those of a perfect sphere leading to the conclusion that the satellite is deformed. Author

N67-24309# National Aeronautics and Space Administration, Washington, D. C.
NASA AND THE MANNED SATELLITE PROGRAM
Morris Tepper *In* Natl. Center for Atmospheric Res. Satellite Data in Meteorol. Res. Dec. 1966 p 333-340 (See N67-24283 12-20)

NASA's flight program plans for the Tiros/TOS satellites, Applications Technology Satellites, and Manned Meteorology Satellites; and projected post-1970 flight programs; are summarized. Also reviewed are procedures for participating in space flight investigations, and the requirement for meteorological research on Mars. S.C.W.

N67-24378# Library of Congress, Washington, D. C. Aerospace Technology Div.
SPACECRAFT UTILIZING THE LIFTING AND BALLISTIC REENTRY TECHNIQUES. PART I: SPACECRAFT MANEUVERING AND DESCENT SYSTEM HARDWARE
Aleksander Dolgich and Kenneth Thomas 29 Jun. 1966 65 p refs
(ATD-66-81, Pt. I; AD-647646) CFSTI: HC $3.00/MF $0.65

The compilation and analysis of extracts and reviews is based on Soviet-Satellite-Western open sources published 1963-1966. This report is Part I of a two-part report. Describing various aspects of the Soviet space program, it attempts to reveal the status and trends of Soviet research and development relating to the orbiting, maneuvering, deorbiting, reentry, and recovery of aerospace vehicles utilizing aerodynamic lifting and ballistic reentry techniques. After the Introduction which reviews information contained in the report, there are three sections: I. Voskhod-type descent systems; II. Materials on lunar- and planetary-probe descent systems; III. Spacecraft maneuvering systems. In Section I there are five parts: A. General discussion of reentry and landing systems; B. Excerpts from articles on reentry, braking, and landing systems; C. Materials on Voskhod-type soft-landing systems; D. Materials on Voskhod-type ion velocity-vector plotters; E. Materials on cosmonaut-recovery procedures. Section II has two parts: A. General discussion of shock-absorbing and landing systems; B. Materials on the Luna-type probes power units and soft-landing systems. Section III has three parts: A. Materials on Polet-type maneuvering systems; B. Soviet activity in the development of electrical-engine-type maneuvering systems; C. General-discussion materials on electrical space-engine development. Section III includes materials on maneuvering systems based on liquid-propellant engines and systems using electrical engines similar to those first tested on Zond 2. Author (TAB)

N67-24451# European Space Research Organization, Paris (France).
PROCEEDINGS OF THE SECOND ESRO SUMMER SCHOOL ON SPACECRAFT TECHNOLOGY. VOLUME I: INTRODUCTION
Oct. 1966 166 p refs Conf. held at Oxford, 11-12 Aug. 1964
(ESRO-SP-9) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. EUROPEAN SPACE RESEARCH ORGANIZATION P. Auger 7 p (See N67-24452 12-31)
2. RADIATIONS IN SPACE P. Auger 6 p (See N67-24453 12-29)
3. SPACE SCIENCE AND TECHNOLOGY THE ESRO PROGRAMME A. W. Lines 11p (See N67-24454 12-30)
4. KINEMATICS OF SPACECRAFT LAUNCHING J. Vandenkerckhove 40 p refs (See N67-24455 12-31)
5. THE LAUNCH VEHICLE J. Vandenkerckhove 32 p refs (See N67-24456 12-31)
6. EFFECTS OF THE LAUNCH VEHICLE ON SPACECRAFT DESIGN J. Vandenkerckhove 23 p refs (See N67-24457 12-31)
7. SPACECRAFT ORBITS G. E. Cook 42 p refs (See N67-24458 12-30)

N67-24452# European Space Research Organization, Paris (France).
EUROPEAN SPACE RESEARCH ORGANISATION
P. Auger *In its* Spacecraft Technol., Vol. 1 Oct. 1966 7 p In FRENCH (See N67-24451 12-31)

Scientific and technical research techniques are very briefly reviewed in relation to the European Space Research Organization in conference remarks of the Director General of ESRO, Oxford, August 10, 1964. The characteristics, history, and projected program of ESRO are summarized. Transl. by R.Li.

N67-24455# European Space Technology Center, Delft (Netherlands).
KINEMATICS OF SPACECRAFT LAUNCHING
J. Vandenkerckhove *In* ESRO Spacecraft Technol., Vol. I Oct. 1966 40 p refs (See N67-24451 12-31)

Conventional rocket vehicles are considered with respect to mass ratio, injection into orbit, and launching constraints.

Equations are presented for a single-stage rocket-powered vehicle during the propulsive phase of its ascent. The relative importance of payload and propellant weight is stressed. Requirements in velocity increments for several typical missions are examined for a multistage rocket. The case of a two-stage satellite launch vehicle capable of imparting, in the absence of losses, an increment velocity of about 10,000 m/sec is considered. A brief analysis of orbit injection through direct ascent, Homann transfer trajectories used to obtain high orbits, and out-of-plane maneuvers are presented. Geographical, time, and systems constraints on choice of trajectories to be obtained are outlined. S.P.

N67-24456# European Space Technology Center, Delft (Netherlands).
THE LAUNCH VEHICLE
J. Vandenkerckhove *In* ESRO Spacecraft Technol., Vol. I Oct. 1966 32 p refs (See N67-24451 12-31)

Data on satellite and probe launch vehicles especially oriented toward Scout, Thor-Delta, Thor-Agena, and Atlas Agena are presented. Approximate performance of larger vehicles such as Atlas Centaur, Titan, and Saturn are briefly mentioned. A general description of each stage is given which includes performance, reliability, availability, launch facilities, payload constraints, system requirements, and costs. S.P.

N67-24457# European Space Technology Center, Delft (Netherlands).
EFFECTS OF THE LAUNCH VEHICLE ON SPACECRAFT DESIGN
J. Vandenkerckhove *In* ESRO Spacecraft Technol., Vol. I Oct. 1966 23 p refs (See N67-24451 12-31)

The launch vehicle imposes many types of constraints (orbital, dimensional, kinematic, or environmental) on the spacecraft design. Some of these constraints are rather obvious (for instance, it is clear that a satellite must have dimensions compatible with the payload compartment of its launch vehicle); the influence of others can only be expressed through a detailed and rather elaborate mathematical study (for instance, in the case of injection errors). Although, in most cases, the constraints imposed by the launch vehicle predominantly influence the spacecraft design, they appear difficult to study in a systematic way because the influence of these constraints, and often even their very nature, can vary from one project to another. Author

N67-24461# European Space Research Organization, Paris (France).
PROJECT ELOISE: PROPOSAL FOR A EUROPEAN LARGE ORBITING INSTRUMENT FOR SOLAR EXPERIMENTS
Aug. 1966 125 p refs Proc. of the ESRO Colloq. held in Nice, 14–15 Jun. 1965
(ESRO-SP-7) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. GENERAL INTRODUCTION TO PROJECT "ELOISE" K. O. Kiepenheuer (Fraunhofer Institut) p 3–8 (See N67-24462 12-31)

2. OPTICAL OBSERVATION OF SOLAR ERUPTIONS WITH A LARGE SATELLITE R. Michard (Observatoire de Paris) p 9–13 (See N67-24463 12-30)

3. X-RAY FLARES C. de Jager (Utrecht State Univ.) p 15–19 refs (See N67-24464 12-29)

4. CHROMOSPHERIC PROBLEMS AND THEIR INVESTIGATION WITH A LARGE ASTRONOMICAL SATELLITE M. Minnaert (Utrecht State Univ.) p 21–29 (See N67-24465 12-29)

5. PHOTOSPHERIC PROBLEMS J. Roesch (Observatoire du Pic-du-Midi) p 31–37 (See N67-24466 12-29)

6. THE NASA SOLAR OBSERVATORY SATELLITES H. J. Smith (NASA, Washington) p 39–50 (See N67-24467 12-31)

7. ATTITUDE CONTROL SYSTEM OF THE PROPOSED LARGE ASTRONOMICAL SATELLITE L. A. Husain (European Space Technology Center) p 51–56 (See N67-24468 12-31)

8. PROJECT "SPECTRO-STRATOSCOPE" J. P. Mehltretter (Fraunhofer Institut) p 57–62 (See N67-24469 12-30)

9. TELEMEASURE PROBLEMS CONCERNING A SOLAR OBSERVATION SATELLITE (PROJECT "ELOISE") P. Blassel (European Space Technology Center) p 63–73 (See N67-24470 12-30)

10. IMAGING DETECTOR TECHNIQUES FOR ORBITING SOLAR OBSERVATORIES A. Boksenberg (Univ. Coll.) p 75–108 refs (See N67-24471 12-31)

11. PROPOSAL FOR A LARGE EUROPEAN SOLAR SATELLITE (ELOISE: EUROPEAN LARGE ORBITING INSTRUMENTATION FOR SOLAR EXPERIMENTS). APPENDIX 1 p 109–122 (See N67-24472 12-31)

N67-24462# Fraunhofer Institut, Freiburg (West Germany).
GENERAL INTRODUCTION TO PROJECT "ELOISE"
K. O. Kiepenheuer *In* ESRO Proj. ELOISE: Proposal for a European Large Orbiting Instr. for Solar Expt. Aug. 1966 p 3–8 (See N67-24461 12-31)

Progress is reported on Project ELOISE (European Large Orbiting Instrumentation for Solar Experiments). The value of an orbiting telescope is appraised by comparing its advantages and disadvantages with those of ground observations, balloon-borne telescopes, and sounding rockets. It is the only instrument which combines long observation periods and good image quality. A guiding principle, program, instrumentation, and telemetry for the project are discussed. R.N.A.

N67-24467# National Aeronautics and Space Administration, Washington, D. C.
THE NASA SOLAR OBSERVATORY SATELLITES
Henry J. Smith *In* ESRO Proj. ELOISE: Proposal for a European Large Orbiting Instr. for Solar Expt. Aug. 1966 p 39–50 (See N67-24461 12-31)

NASA's Orbiting Solar Observatory (OSO) and Advanced Orbiting Solar Observatory (AOSO) are described in terms of their configurations, performance capabilities, command and data handling systems, stabilization and control systems, and scientific missions. Emphasis is placed on the experiments being developed for the AOSO missions which include a high resolution X-ray telescope, a spectrometer-spectroheliograph fed by a 9-inch mirror telescope, a scanning spectrometer-spectroheliograph fed by a 9-inch mirror telescope, a scanning spectrometer-monochromator functioning as a spectroheliograph, and a white light coronagraph. R.N.A.

N67-24468# European Space Technology Center, Delft (Netherlands).
ATTITUDE CONTROL SYSTEM OF THE PROPOSED LARGE ASTRONOMICAL SATELLITE
L. A. Husain *In* ESRO Proj. ELOISE: Proposal for a European Large Orbiting Instr. for Solar Expt. Aug. 1966 p 51–56 (See N67-24461 12-31)

The design objectives, proposed concept, and method of achieving attitude control for the ESRO Large Astronomical Satellite are summarized. The concept, presented as a possible basis for use by Project ELOISE, is essentially a self-contained pointable platform to which a variety of packages may be attached. Two diametrically opposed star tracker platforms provide the space reference. Twin platforms are used to avoid occultation of the star trackers by the spacecraft body. The environmental control problem may be solved by using a continuous sunlight synchronous polar orbit. The probable characteristics of the satellite are tabulated. R.N.A.

N67-24471# University Coll., London (England). Dept. of Physics.
IMAGING DETECTOR TECHNIQUES FOR ORBITING SOLAR OBSERVATORIES
A. Boksenberg *In* ESRO Proj. Eloise: Proposal for a European Large Orbiting Instr. for Solar Expt. Aug. 1966 p 75–108 refs (See N67-24461 12-31)

Various types of storage and non-storage television camera tubes being considered for use as image detectors in orbiting solar observatories are described. The storage camera tubes include the cathode potential stabilized emitron, image orthicon, vidicon, plumbicon, ebicon, uvicon, and secondary electron conduction vidicon. The non-storage camera tubes described are the image dissector, image intensifier, photocathode phosphor intensifier, transmission secondary emission intensifier, and channeled intensifier. The capabilities and possibilities of the various tubes are compared and discussed. R.N.A.

N67-24472# European Space Research Organization, Paris, (France).
PROPOSAL FOR A LARGE EUROPEAN SOLAR SATELLITE (ELOISE: EUROPEAN LARGE ORBITING INSTRUMENTATION FOR SOLAR EXPERIMENTS). APPENDIX 1
In its Proj. ELOISE: Proposal for a European Large Orbiting Instr. for Solar Expt. Aug. 1966 p 109–122 (See N67-24461 12-31)

A proposal is made for a large European solar satellite to study the fine structures of the solar atmosphere in both normal and active regions with optimum spatial resolution. Because of limitations in telescope apertures and detector sensitivities, it is proposed that the satellite study individual centers of activity or other selected portions of the sun by obtaining images of the region in several parts of the spectrum, and by analyzing the light from some part of the region in greater spectral detail. Considerations affecting the choice of wavelength regions for imaging and spectra are discussed. The satellite's solar instrumentation and telemetry are briefly described, and the scientific value of photospheric observations in the continuum and of spectral line observation is examined. R.N.A.

N67-24548*# National Aeronautics and Space Administration, Washington, D. C.
FIRST U.S.-ESRO SATELLITE LAUNCH LATE THIS MONTH
10 May 1967 18 p
(NASA News Release-67-110) Available from the Scientific and Technical Information Division CSCL 22B

A NASA press kit release concerning the first U.S.-ESRO satellite (ESRO II) launch is presented. Experiments conducted by the satellite will investigate 1) X-ray radiation emitted by the sun, 2) corpuscular radiation of the sun, 3) particles trapped in the magnetic field of the earth, 4) cosmic ray particles, 5) the electron component of primary cosmic radiation, and 6) solar X-ray flux correlation with heating and ionization in the ionosphere. Descriptions are given of the following spacecraft and subsystems: telemetry, data storage, antenna, command, power, solar array, battery, attitude control, de-spin, spin-up, nutation damping, housekeeping, and thermal control. The flight sequence of the launch vehicle is outlined; and other pertinent information concerning the project (e.g. participants, and memo of understanding between ESRO and NASA) are given. L.S.

N67-24601*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
AN ADVANCED STUDY OF AN APPLICATION TECHNOLOGY SATELLITE (ATS-4) MISSION, VOLUME I, BOOK 1 Final Study Report, May–Nov. 1966
9 Nov. 1966 384 p
(Contract NASw-1410)
(NASA-CR-81604; DOC.-66SD4529, Vol. I, Bk. 1) CFSTI: HC $3.00 CSCL 22B

The general mission of the Applications Technology Satellite (ATS-4) is discussed, and a comprehensive summary is given of the design of the baseline spacecraft. The project objectives and their feasibility are considered, and the experiments to be conducted are described. The program objectives were stated to include establishing the feasibility of developing a large aperture, deploying satellite antenna and the precision spacecraft stabilization techniques required for accurate orientation of a parabolic antenna, a phased array, and an interferometer. A feasible spacecraft configuration is defined and an analysis of the performance capabilities is presented. A preliminary program plan for spacecraft development including identification of and approaches to the solution of engineering development problems and an estimate of the program schedule and development costs is included. L.E.W.

N67-24602*# General Electric Co., Philadelphia, Pa. Missile and Systems Div.
AN ADVANCED STUDY OF AN APPLICATION TECHNOLOGY SATELLITE (ATS-4) MISSION, VOLUME I, BOOK 2 Final Study Report, May–Nov. 1966
9 Nov. 1966 536 p refs
(Contract NASw-1410)
(NASA-CR-81767; DOC.-66SD4529, Vol. I Bk. 2) CFSTI: HC $3.00 CSCL 22B

A discussion is presented of the system and subsystem tradeoff considerations which led to the selection of the preferred spacecraft approach for the Applications Technology Satellite (ATS-4). The analysis also identified an alternate approach that offers slightly better rf performance at the expense of deployment complexity. Details are given on the configuration selection; paraboloid antenna; guidance and control; tracking, telemetry, and command; power; spacecraft design; and apogee motor selection. L.E.W.

N67-24603*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
AN ADVANCED STUDY OF AN APPLICATION TECHNOLOGY SATELLITE (ATS-4) MISSION, VOLUME I, BOOK 3 Final Study Report, May–Nov. 1966
9 Nov. 1966 468 p refs
(Contract NASw-1410)
(NASA-CR-81766; DOC.-66SD4529, Vol. I Bk. 3) CFSTI: HC $3.00 CSCL 22B

The launch phase sequence, experiment selection and operational sequence, ground equipment and ground station considerations, and technical appendices are presented for the Applications Technology Satellite (ATS-4). The flight dynamics concerned with placing the ATS-4 into an earth synchronous equatorial orbit are discussed. Each of the major operational events from launch vehicle liftoff to stabilization in the synchronous orbit are discussed with the rationale for the selected launch trajectory. The experiments and measurements program is described, including the derivation of measurement requirements from mission objectives, formulation of measurements procedures, integration of the procedures into the overall program, and the derivation of experiment equipment requirements. In the area of support operations, consideration is given to equipment requirements, mechanical support equipment electrical support equipment, test facilities, launch facilities, orbital support, and software. L.E.W.

N67-24604*# Fairchild Hiller Corp., Germantown, Md. Space Systems Div.
ATS-4 STUDY PROGRAM, VOLUME 1 Final Report
Dec. 1966 70 p
(Contract NASw-1411)
(NASA-CR-81616; SSD-102.3, Vol. 1) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Experiments conducted in the two year mission in equatorial synchronous orbit are analyzed, and the subsystem summaries are presented. The four principal experiments are identified as: (1) deployment, pointing, and utilization of a large parabolic antenna for simultaneous multifrequency communications; (2) active spacecraft stabilization with possible augmentation by passive means; (3) deployment, pointing, and utilization of a high gain, multibeam, electronically steered array; and (4) demonstration of a precision radio interferometer as a sensor for spacecraft attitude and/or antenna pointing reference. The parabolic antenna, stabilization and control system, phased array, and interferometer are briefly described. N.E.N.

N67-24605*# Fairchild Hiller Corp., Germantown, Md. Space Systems Div.
ATS-4 STUDY PROGRAM, VOLUME 2 Final Report
Dec. 1966 141 p
(Contract NASw-1411)
(NASA-CR-81615; SSD-102.3, Vol. 2) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Details are presented on the systems analysis for the Applications Technology Satellite-4, and operations plan are outlined. The evaluation test is given for the parabolic antenna, phased array, interferometer, and attitude control experiments. The power supply and power loads for the various experiments are described, and weight factors are summarized. Antenna accuracy and efficiency, and the failure modes for the systems and operations are discussed. N.E.N.

N67-24606*# Fairchild Hiller Corp., Germantown, Md. Space Systems Div.
ATS-4 STUDY PROGRAM, VOLUME 3 Final Report
Dec. 1966 290 p
(Contract NASw-1411)
(NASA-CR-81603; SSD-102.3, Vol. 3) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The engineering considerations for the ATS-4 development are discussed. Details are presented on the concept evolution and evaluation. The design and fabrication of the deployable trussed frame petal antenna reflector are described. The structural, dynamic, and thermal analyses of the satellite and its components are emphasized. Literature pertaining to the effects of residual, thermal, and mechanical loading stresses on the dimensional stability of metal structures in space is included. The techniques for determining in-orbit antenna surface accuracy are reviewed. Expandable truss antennas, inflatable antennas, rigid panel antennas, and petal axis of rotation determination are also discussed. N.E.N.

N67-24607*# Fairchild Hiller Corp., Germantown, Md. Space Systems Div.
ATS-4 STUDY PROGRAM, VOLUME 4 Final Report
Dec. 1966 139 p
(Contract NASw-1411)
(NASA-CR-81599; SSD-102.3, Vol. 4) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The power subsystem and the orbital analysis are presented for the ATS-4. A study of the power output vs time characteristics over the orbital period resulted in the choice of a cruciform design with two double-faced panels. The solar cell radiation degradation was computed, and the battery characteristics were determined. The results of studies relating to trajectory and orbital analyses are given, including launch vehicles, apogee injection stages, ascent trajectories and injection stations, orbit payloads, orbit injection errors, orbit perturbation, orbit guidance, and auxiliary propulsion systems. N.E.N.

N67-24608*# Fairchild Hiller Corp., Germantown, Md. Space Systems Div.
ATS-4 STUDY PROGRAM, VOLUME 5 Final Report
Dec. 1966 248 p
(Contract NASw-1411)
(NASA-CR-81562; SSD-102.3, Vol. 5) CFSTI: $3.00 CSCL 22B

Consideration is given to the attitude stabilization and control system (SCS) of the Applications Technology Satellite (ATS-4). Details are given on stability and control requirements, attitude reference subsystem, disturbance torque model, torquer subsystem, computation and data handling, system operational description, system performance, and system physical description. The requirements imposed on the SCS are stated to be establishment of a desired vehicle orientation, control of the command offset pointing direction of the spacecraft antenna, execution of commanded tracking maneuvers, monitoring of system performance, and performance of certain control system experiments. Numerous control modes are discussed, including ascent and orbit injection, initial rate arrest, acquisition, offset pointing, and satellite tracking. L.E.W.

N67-24609*# Fairchild Hiller Corp., Germantown, Md. Space Systems Div.
ATS-4 STUDY PROGRAM, VOLUME 6 Final Report
Dec. 1966 236 p
(Contract NASw-1411)
(NASA-CR-81769; SSD-102.3, Vol. 6) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Described and analyzed are the parabolic antenna feed, the phased array, and the communications equipment of the Application Technology Satellite experiment. A square array of four paraboloids fed in an off-set arrangement are studied as an alternate to prime focus and Cassegrain configurations; it appears as if tolerance requirements of the four-dish configuration are less stringent. G.G.

N67-24610*# Fairchild Hiller Corp., Germantown, Md. Space Systems Div.
ATS-4 STUDY PROGRAM, VOLUME 7 Final Report
Dec. 1966 383 p
(Contract NASw-1411)
(NASA-CR-81769; SSD-102.3, Vol. 7) CFSTI: HC $3.00 CSCL 22B

The direct phase reading X-band radio interferometer as the ATS-4 attitude sensor is discussed. Studies indicated that separate antenna systems for the interferometer and the phased array are preferred. The general circuit, mechanical and thermal design, and physical characteristics are discussed, and an error analysis is presented. Other concepts are also described. N.E.N.

N67-24611*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
ADVANCE STUDY OF AN APPLICATIONS TECHNOLOGY SATELLITE (ATS-4) MISSION Final Report
30 Nov. 1966 525 p refs
(Contract NASw-1412)
(NASA-CR-81765; LMSC-A847537) CFSTI: HC $3.00 CSCL 22B

Details are given on the mission of the Applications Technology Satellite (ATS-4) whose primary purpose it is to demonstrate the employment of large-aperture antennas in conjunction with precision spacecraft stabilization techniques. Information is given on experiment description, spacecraft description, ascent performance and stationkeeping, ground system definition, development approach, and schedules and cost. A number of alternatives were studied in the areas of launch vehicles, spacecraft configurations, subsystems, and experiments. The study concluded that the spacecraft and the experiments are feasible, that meaningful experiments can be

conducted with a spacecraft placed in synchronous orbit by existing launch vehicles, and that the spacecraft development will advance the state of the art without requiring major inventions. L.E.W.

N67-24621* Radiation, Inc., Melbourne, Fla.
ADDENDUM TO FINAL REPORT FOR NIMBUS DESIGN STUDY, VOLUME 2
[1966] 201 p
(Contract NAS5-3787)
(NASA-CR-83729) CSCL 22B

Details are given on the Nimbus satellite design study, including drawings of various systems and components, failure reports, failure rate data sheets, mechanical model test reports on vibration tests of the Nimbus pulse code modulation and the telemetry electronics unit, encoding accuracy, and handling of metal oxide silicon field effect transistors. A glossary of terms is also included. L.E.W.

N67-24638* Honeywell, Inc., Minneapolis, Minn. AFS Aerospace Div.
A LOAD RELIEF CONTROL SYSTEM FOR THE S-IC STAGE OF THE SATURN V WITH VOYAGER PAYLOAD
T. W. Chase, E. D. Skelley, and G. D. White 10 Jan. 1967 177 p refs
(Contract NAS8-11206)
(NASA-CR-83727; Rept.-12003-SV6) CSCL 22D

Design concepts are defined for a load relief control system which would provide a high probability of launch during the May through November launch period. Synthetic nondirectional 95% probability winds expected during the period are described, and a control system was designed to permit launches in these synthetic winds. Primary performance objectives were met, and stability design objectives were evaluated by point stability analysis at selected times during the 158-second first stage flight. Center of pressure, normal force coefficient control system gains, and bending frequencies were varied within specified tolerances with negligible effect on system performance. Wind data used in the simulations developed for performance analysis are presented, along with an analog approximate simulation for the initial studies and a digital complete simulation for final performance evaluation. Although the controller configuration appears suitable for the Saturn/Voyager, it is pointed out that additional design must be done to define a system for mechanization. M.G.J.

N67-24639* Planning Research Corp., Los Angeles, Calif.
STUDY OF THE MARINER MARS 66 SPACECRAFT
W. R. Hughes, E. E. Bean, and D. R. Arnold 7 Feb. 1964 119 p refs Prepared for JPL
(Contract NAS7-100)
(NASA-CR-83726; PRC-R-464) CSCL 22B

Reported is a study of the Mariner Mars 66 spacecraft mission based on the design of the Mariner C spacecraft. The study has resulted in predicted probabilities of 0.19 of successfully transmitting the encounter TV science data to earth and 0.08 of successfully releasing the instrumented capsule for Martian landing. The probabilities were calculated considering catastrophic failures only, and using only the planned sequence of events. The study also examined the telemetry information and the command systems logic to determine the outcome of possible corrective actions in case of equipment failures. The study concludes with recommendations for additional equipment redundancies in four subsystems that will raise the success probabilities to a value where the mean-time-to-failure about equals mission time. Author

N67-24944# Research Analysis Corp., McLean, Va.
A NONLINEAR PROGRAMMING MODEL FOR LAUNCH VEHICLE DESIGN AND COSTING
Benjamin C. Rush, Jerome Bracken, and Garth P. McCormick Sep. 1966 35 p refs
(Contract DA-44-188-ARO-1)
(RAE-TP-231; AD-643052) CFSTI: HC $3.00/MF $0.65

A nonlinear programming model is developed that has as the objective function (to be minimized) total cost of the development, manufacture, and launching of a launch vehicle. Constraints on physical interrelationships, basic performance relationships, and desired achievements are given as functions of the variables. The variables are physical properties of the launch vehicle such as airframe weight, total inert weight, mass fraction, thrust, propellant weight, length, and other similar properties. The model is for the purpose of assisting in launch vehicle design by generating designs that have minimum cost for selected performance characteristics. Previous work has mostly been in estimating or predicting costs of given designs. This model goes one step further in that it uses cost-estimating relationships to influence the design. The nonlinear programming models are not convex. The basic model has 25 variables, 34 inequality constraints, and 9 equality constraints. Nonnegativity restrictions hold on all the variables. The nonlinear programming problems have been solved using the sequential unconstrained minimization technique. Author (TAB)

N67-25002*# National Aeronautics and Space Administration, Washington, D. C.
EUROPEAN SPACE VEHICLE LAUNCHER DEVELOPMENT ORGANIZATION ACTIVE COMMUNICATIONS SATELLITES [DIRECTION DES PROGRAMMES ULTERIEURS ET DES ETUDES AVANCES]
M. Gilli Apr. 1967 46 p Transl. into ENGLISH from Tech. Memo. F-37
(NASA-TT-F-10841; F-37) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Data sheets are presented on both launched and projected active communications satellites. The information given includes the weight, shape, dimensions, launch date, and booster; orbital data; type of power source; weights of structure, power source, stabilization system, and telecommunications equipment; communications facilities; and costs. The satellites are also classified according to those intended for civilian or military use. M.G.J.

N67-25044*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SYNCOM ENGINEERING REPORT, VOLUME II
Washington, NASA, Apr. 1967 202 p refs
(NASA-TR-R-252) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Details are given on the launch of the Syncom III satellite, its performance during the first 100 days in orbit, the televising of the 1964 Summer Olympic Games by means of the satellite, and various communications tests conducted with it. Syncom III was launched on 19 August 1964. All three stages of the thrust-augmented Delta vehicle performed satisfactorily and subsequent orbital maneuvers placed the satellite into a nominally synchronous equatorial (stationary) orbit over the International Date Line. Live television of the Olympic Games from Japan via Syncom III was a technical success. The satellite also enabled the establishment of the first 24-hour-per-day, 7 day-per-week reliable communications network across the Pacific Ocean. The attainment of a stationary orbit, which permits the use of fixed ground antennas without the expense of costly tracking systems, and Syncom III's excellent performance indicate the operational and economic advantages of the synchronous communication satellite. Author

N67-25045*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
POSTFLIGHT EVALUATION OF ATLAS–CENTAUR AC-8 (LAUNCHED APRIL 7, 1966)
Washington, NASA, Apr. 1967 187 p refs
(NASA-TM-X-1343) CFSTI: HC $3.00/MF $0.65 CSCL 22D

The AC-8 Atlas–Centaur vehicle, carrying a 1730-pound-mass model of the Surveyor payload, was successfully launched in an attempted two-burn mission. Flight profile through boost phase, Centaur first burn, orbit injection, and the 25-minute orbital coast was normal. However, the second main engine burn required to transfer the spacecraft from the parking orbit into a lunar intercept trajectory was not accomplished because of a deficiency of hydrogen peroxide to operate the boost pumps. Early depletion of the peroxide appears to have resulted from a leak in the system during the extended coast period. A very significant achievement was the positive control of tank pressure and residual propellants throughout the entire 25-minute, low g coast period. A non-propulsive hydrogen tank venting system together with energy dissipation devices and variable propellant settling thrust levels to suppress liquid disturbances and control propellant location were adequately and successfully demonstrated. Propellants were retained in a settled condition and would have supported a second engine burn, with satisfactory propellant boost pump operation. Author

N67-25050* Westinghouse Electric Corp., Baltimore, Md. Defense and Space Center.

HANDBOOK OF ORBIT POSITION CONTROL FOR PASSIVE COMMUNICATIONS SATELLITES

Washington, NASA, May 1967 204 p refs

(Contract NAS1-5194)

(NASA-CR-730) CFSTI: $3.00 CSCL 22B

An introductory discussion is presented of orbit position control techniques using direct solar pressure and thermal reradiation forces to control the orbit energy and the relative angular position of satellites in orbit. Complete parametric data are presented related to these techniques, along with derivations of scaling factors and other related information. Author

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N67-23498# Forest Products Lab., Madison, Wis.

EDGEWISE COMPRESSIVE PROPERTIES OF TITANIUM AND NICKEL-BASE SANDWICH CONSTRUCTIONS AT ELEVATED TEMPERATURES

Paul M. Jenkinson Nov. 1966 32 p refs

(Contract AF 33(615)-5002)

(FPL-68; AD-645455) CFSTI: HC $3.00/MF $0.65

The performance was evaluated of sandwich constructions of titanium and nickel-base alloys having facings resistance-welded to honeycomb cores. Cores were of corrugated foil formed to 1/4-inch-square honeycomb cells. Properties in edgewise compression, flatwise tension, flatwise compression, and flatwise shear were evaluated at 75 F. for three constructions of each type. Edgewise compressive properties were also evaluated at temperatures of 400, 800, and 1200 F. for the titanium sandwich and at 800, 1200, 1400, and 1600 F. for the nickel-base sandwich. The edgewise compressive strength-temperature relationship was nearly linear between 75 and 1200 F. for the titanium sandwich constructions, the strength at 1200 F. being about 30 percent of that at 75 F. The edgewise compressive strength of the nickel-base sandwich constructions at 1200 F. was about 85 percent of that at 75 F., 70 percent at 1400 F., and 30 percent at 1600 F. The titanium sandwich constructions were found to have the greatest strength-to-weight ratios below about 900 F., but above that temperature the nickel-base sandwich constructions had the greatest strength-to-weight ratios. TAB

N67-23499# New Mexico Univ., Albuquerque. Bureau of Engineering Research.

ON STABLE FRACTURES IN A UNIAXIAL STRESS FIELD

F. D. Ju and B. P. Shafer Dec. 1966 212 p refs

(Grant AF-AFOSR-568-66)

(SR-68-1249; AD-645168) CFSTI: HC $3.00/MF $0.65

The purpose of this investigation was to produce a stable fracture which satisfied the Irwin-Griffith postulation and to measure the critical strain field in the neighborhood of the fracture tip. By the energy method, four guidelines of experience was obtained. (1) A constant displacement end condition for the plate must be enforced. (2) Fracture must be initiated at low total plate displacement. (3) The plate width should be sufficient to sustain a stable fracture length of the order of 1.0 inch without significant edge effect. Various perturbative effects resulting from the application of the birefringent coating technique to this problem were investigated. The coating thickness and reinforcing effects were compensated by a correction factor. The difficulty of simultaneous fracture of base metal and coating was avoided by applying the coating after fracture. The strain measurement by the birefringent coating method was successfully carried out for the fractured plates. The experimental stress intensity functions were obtained for a number of stable fracture lengths. In general, the experimental data were in agreement with the Inglis solution for large values of isochromatic radius r sub m, but the data were more closely approximated by the Williams solution for small values of r sub m. The experimental stress divergence rate r was found to be proportional to r sub m to the minus .38 power as compared to the analytical result of r sub m to the minus .50 power. TAB

N67-23526 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

FOR DETERMINATION OF PROBABILITY OF FATIGUE BREAKDOWN DURING RANDOM STATIONARY LOADING

A. S. Isayev *In its* Structural Strength of Light Alloys and Steels 13 May 1967 p 41–51 refs (See N67-23521 12-17)

A method is proposed for calculating fatigue damage during the action of a stationary random load which is sufficiently simple, since it is based on the hypothesis about linear accumulation of damage. It considers the inconstancy of the coefficient of asymmetry of a cycle in a random load, which makes it possible to renounce the frequently taken assumption about the fact that on the average the load is changed with respect to the symmatric cyle. This method permits one to consider scattering of sample properties and to calculate the probability of fatigue breakdown according to time. Author

N67-23527 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EXPERIMENTAL INVESTIGATION OF FATIGUE FOR RANDOM LOADING

A. S. Isayev *In its* Structural Strength of Light Alloys and Steels 13 May 1966 p 53–68 refs (See N67-23521 12-17)

Present methods of calculated determination of endurance and tests of structural elements which are subjected to random loading, do not consider a number of factors characterizing the change of a load according to time, and are not checked experimentally in conditions of loading which are close to actual. An installation is described that permits modelling, in laboratory conditions, of random stationary loading which possesses an ergodic property, with a different spectral density, dispersions, and mathematical expectations. On the installation, the influence of different statistical characteristics of loading can be investigated separately. The experimentally produced values of the coefficient of equivalence connect the mean square deviation of a random load with the amplitude of an equivalent harmonic load. The development of a fatigue crack during random and harmonic loading (for a selected type of samples) carries a different character in principle.

With the help of developed methods of tests and equipment, the correctness of any hypothesis of accumulation of damages in conditions of random loading can be checked. Author

N67-23528 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STRESS CONCENTRATION AND CREEP FLOW IN PLATES OF ALUMINUM ALLOYS
S. V. Serensen and N. A. Borodin *In its* Structural Strength of Light Alloys and Steels 13 May 1966 p 69–79 refs (See N67-23521 12-17)

Stress concentration and creep flow were studied in both smooth aluminum plates and in plates with a centrally located hole. Precision dividing grids were scratched on the plate surfaces to measure deformation. Results show that a weakening occurs in the influence of stress concentration on the rupture strength of the plates and is explained by stress relaxation. The rate of stress relaxation depends on the initial gradient of stresses. With a gradient decrease, the rate of stress relaxation decreases, which leads to the decrease of testing time of the sample until the beginning of local deformation and the time to its total destruction. The loss of deformation stability in the area of the hole formation is connected with the magnitude of total creep flow in this zone. During the course of testing time, the creep rate of layers, remote from the hole contour, becomes higher than the layer which is directly adjacent to the contour, which leads to a displacement of the maximum of deformation and to sublayer destruction. R.N.A.

N67-23531 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
REGULARITY OF CRACK DEVELOPMENT AND FRACTURE OF HULL STEEL WITH CYCLIC LOADING
S. V. Serensen and N. A. Makhutov *In its* Structural Strength of Light Alloys and Steels 13 May 1966 p 119–133 refs (See N67-23521 12-17)

The failure criterion for flat notched samples at over 2000 cycles is the limiting local plastic deformation accumulated in the peak of the developed crack. The magnitude of this deformation depends on the degree of homogeneity and the capacity of the strained condition which monotonically decreases with the decrease of the radius of curvature in the top of the notch and the increase of sample thickness. The magnitude of local plastic deformation after the first loading monotonically increases with stress growth. Plastic deformation, accumulated for N cycles, at the failure stage depends on plastic deformation after the first loading. The crack length after N cycles of loading depends on the degree of homogeneity and the capacity of the strained condition and on the magnitude of deformation after first loading. The limiting length of the final crack monotonically increases with the increase of cycles to failure and with an increase of the capacity of the strained condition. R.N.A.

N67-23532 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INFLUENCE OF LOADING CONDITIONS ON FAILURE OF LOW-ALLOY HULL STEEL
N. A. Makhutov *In its* Structural Strength of Light Alloys and Steels 13 May 1966 p 135–148 (See N67-23521 12-17)

The failure criterion of hull steels, regardless of the preloading process, is accumulated plastic deformation and is identical for samples fractured with both single and cyclic loading with an assigned amplitude of stresses. The fracture of smooth cylindrical samples occurred with neck formation with small surface cracks appearing in the last cycles before failure. The failure criterion for flat notched samples during repeated tension is local plastic deformation which accumulated in the peak of the developed crack. Deformation increases with an increase of the radius of curvature and decreases with an increase of sample thickness. Repeated tension at room temperature for flat notched samples lowered the brittle strength at −196°C. The decrease of brittle strength at −196°C is proportional to the logarithm of the product of the crack length and local plastic deformation and is monotonic with the increase of the number of cycles of preloading and plastic deformation after the first loading. This decrease is caused by less plasticity of samples in the zone of brittle fracture in comparison with samples not subjected to repeated preloading. R.N.A.

N67-23533# College of Aeronautics, Cranfield (England).
DEVELOPMENTS IN THE THEORY OF MICHELL OPTIMUM STRUCTURES
D. M. Richards and H. S. Y. Chan (Oxford Univ.) Paris, AGARD, Apr. 1966 25 p Presented at the 22d Meeting of the Structures and Mater. Panel, Delft, Netherlands, 18–22 Apr. 1966
(AGARD-543) CFSTI: HC$3.00/MF$0.65

The fundamental problem of optimum structural design is discussed. Solutions to specific problems suggested by the theorem of Mitchell, are described. Suggestions for the practical realisation of Michell type structures as frameworks, fibrous composites, variable thickness plates and shells are examined, and work leading to approximate solution by digital programming methods is reported. Author

N67-23541# Sandia Corp., Albuquerque, N. Mex.
A COMPUTER PROGRAM, SRATE, FOR THE STUDY OF STRAIN-RATE SENSITIVE STRESS WAVE PROPAGATION. PART I
B. M. Butcher Sep. 1966 54 p refs
(Contract AT(29-1)-789)
(SC-RR-66-298) CFSTI: HC$3.00/MF$0.65

A computer program, Srate, that can be used to study one-dimensional stress wave propagation in certain strain-rate sensitive materials is described. Problems are limited to stress levels for which the bulk modulus of the material can be assumed constant and the plastic strain rate is a function of stress and strain. Examples of several calculations are given. Author (NSA)

N67-23621# Goodrich (B. F.) Co., Brecksville, Ohio. Research Center.
AN ANALYSIS OF THE ELASTIC DEFORMATIONS OF CYLINDERS WITH CONSTRAINED ENDS UNDER AXIAL LOAD
Harry F. Neff and Samuel J. Caprette, Jr. Aug. 1966 32 p refs
(Contract Nonr-3304(00))
(AD-645152) CFSTI: HC$3.00/MF$0.65

It was shown that the boundary conditions that are normally applied to the elastic deformations of cylinders and prisms with plane, constrained ends and free lateral surfaces are incorrect at the intersection of the plane ends and free surfaces. The assumption of continuity of strain leads to erroneous results in predicting the apparent compressive modulus of such a prism as a function of its geometric dimensions. By allowing a strain discontinuity at the boundary of the free surface, one can derive solutions to the problems of deformations of right circular cylinders and infinite rectangular sections which predict measured values with a high degree of accuracy. Author (TAB)

N67-23634# Lockheed Missiles and Space Co., Palo Alto, Calif.
DEVELOPMENT OF IMPROVED STRUCTURAL DYNAMIC ANALYSIS. VOLUME 1: GENERAL SURVEY Technical Report, Jul. 1966–Aug. 1966

C. W. Coale and K. J. Forsberg Oct. 1966 120 p refs
(Contract AF33(615)-3131)
(LMSC-L-30-66-2; AFFDL-TR-66-187, Vol. 1; AD-645461) CFSTI: HC $3.00/MF $0.65

The stringent design requirements of modern aerospace vehicles have resulted in continuing demands for improvement of methods for structural dynamic analysis. Improved capabilities in this area will arise from increased analytical capability, more extensive techniques for structural synthesis and integration, and from efficient utilization of improvements in computer hardware. In this study attention has been given to three areas: (1) a review of the current state-of-the-art of structural dynamic analysis; (2) a discussion of the areas where attention should be concentrated to advance the present state-of-the-art, with particular attention given to those critical problem areas requiring long-term research; and (3) a discussion of the current and future developments in computer hardware. Particular attention is given to the exciting new field of computer graphics. It is anticipated that the field of active computer graphics will have tremendous impact on methods of structural dynamic analysis. Author (TAB)

N67-23666# Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Flight Dynamics Lab.
AVOIDANCE OF THERMAL STRAIN
William H. Goesch Paris, AGARD, Oct. 1966 23 p refs Presented at the 23d Meeting of the AGARD Structures and Mater. Panel, Paris, 4–11 Oct. 1966
(AGARD-547) CFSTI: HC $3.00/MF $0.65

Thermal structure design concepts are reviewed for the avoidance of thermal strain in high speed aerospace vehicles. Absorptive and radiative design concepts are discussed. Specific arrangements of typical design concepts are shown and examined in respect to problem areas, advantages, and disadvantages. Insulative, absorptive, and radiative materials are reviewed in regard to the design concepts and, when appropriate, specific limits are indicated and problem areas defined. Author

N67-23709 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON NONLINEAR FLUTTER OF PLATES
V. G. Kotyukov *In its* Herald of Moscow Univ. Ser. I: Math. and Mech. 18 Aug. 1966 p 81–86 refs (See N67-23701 12-19) CFSTI: HC $3.00/MF $0.65

Reported is a study on the nonlinear flutter of a rectangular supported plate in a supersonic gas flow. A three-term representation is assumed for the deflection. By Galerkin's method, the problem is reduced to the investigation of a system of three nonlinear equations. By the method of a small parameter, the amplitudes and frequencies of steady-state flutter vibrations are determined to a first approximation. By the same method, the stability of the obtained stationary solution is proved. Author

N67-23710 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SOLUTION OF PROBLEM OF TORSIONAL IMPACT BY METHOD OF SUCCESSIVE APPROXIMATION
R. I. Nadeyeva *In its* Herald of Moscow Univ. Ser. I: Math. and Mech. 18 Aug. 1966 p 87–91 refs (See N67-23701 12-19) CFSTI: HC $3.00/MF $0.65

The paper presents the results of the solution of the problem concerned with strains occurring in an infinite elastic isotropic space when a torque is applied instantaneously on the boundary of a cylindrical cavity. Use is made of Rahmatulin's concept of the method of successive approximations in solving dynamic problems of the theory of elasticity. Author

N67-23711 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON GEOMETRIC TREATMENT OF THEORY OF DISLOCATIONS
B. Ye. Pobedrya *In its* Herald of Moscow Univ. Ser. I: Math. and Mech. 18 Aug. 1966 p 93–103 refs (See N67-23701 12-19) CFSTI: HC $3.00/MF $0.65

Presented is an analysis of the applicability of non-Riemann geometry to the problems of the continual theory of dislocations using the method of Cartan's forms. Author

N67-23790# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
APPLIED MECHANICS
24 Aug. 1966 30 p refs Transl. into ENGLISH from Prikl. Mekh. Akad. Nauk Ukr. RSR (Kiev), v. 1, n. 1, 1965 p 52–61, 92–97
(FTD-TT-65-1375; AD-645819) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. EFFECT OF CYCLIC PLASTIC STRAINS ON METAL FATIGUE IN HOMOGENEOUS AND INHOMOGENEOUS STATE OF STRESS G. S. Pisarenko, V. T. Troshchenko, and V. I. Bugay p 1–15 refs (See N67-23791 12-17)

2. THERMODYNAMIC PRINCIPLES OF RHEOLOGY L. R. Khoroshun p 16–24 refs (See N67-23792 12-32)

N67-23792# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THERMODYNAMIC PRINCIPLES OF RHEOLOGY
L. P. Khoroshun *In its* Appl. Mech. 24 Aug. 1966 p 16–24 refs Presented at the 2d All-Union Congr. on Theoretical and Appl. Mech., 30 Jan. 1964 (See N67-23790 12-32)

Assuming small strains and a constant density of matter, the case of mechanical and thermal processes in a medium is studied. The form of the most general rheological relationships is established. The general problems of plasticity, creep, and strengthening of materials are investigated from the standpoint of thermodynamics. It was found that the strengthening is associated with a separate process in the medium and is characterized by parameters which are second-rank tensors. This representation accounts for the Bauschinger effect, aftereffect, relaxation of the material, dependence of strengthening of the rate of inelastic strains, transition of a part of the mechanical energy into latent strain energy, and the appearance of anisotropy. Author

N67-23799*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
BALLISTIC LIMIT OF DOUBLE-WALLED METEOROID BUMPER SYSTEMS
Richard Madden Washington, NASA, Apr. 1967 18 p refs
(NASA-TN-D-3916) CFSTI: HC $3.00/MF $0.65 CSCL 20K

A model has been developed for the theoretical analysis of double-walled meteoroid bumper systems. The model is applicable for the range of velocities attributed to meteoroids in space. A normal density function has been used to represent the mass of the spray emanating from the bumper. The equations of linear plate theory are used to describe the behavior of the spacecraft main wall and to determine a ballistic limit criterion. A parametric study is performed to determine the effects of pertinent parameters. In addition, the analysis is applied to the determination of the mass distribution between bumper and main spacecraft wall that results in the greatest ballistic limit velocity for the system. The model has yielded a simple ballistic limit equation that may be used by designers of spacecraft. The equation illustrates that the ballistic limit velocity is proportional to the square of the spacing between walls and also that the highest ballistic limit velocity is achieved when the mass per unit area of the bumper equals the

mass per unit area of the main wall. The theory has predicted the same trends evidenced in the highest velocity experimental data available in the literature. Author

N67-23925# California Univ., Berkeley. Structural Engineering Lab.
VARIATIONAL FORMULATIONS OF THE COUPLED THEORY OF LINEAR THERMOELASTICITY
R. E. Nickell and J. L. Sackman Oct. 1966 42 p refs
(Contract DA-31-124-ARO(D)-460)
(Rept.-66-21; AROD-4547-20; AD-645301) CFSTI: HC $3.00/MF $0.65

Several variational principles are derived for the initial-boundary-value problem of fully coupled linear thermoelasticity for an inhomogeneous, anisotropic continuum. A consistent set of field variables is employed and a method based on the Laplace transform is used to incorporate the initial conditions explicitly into the formulation. These principles lend themselves readily to numerical solutions based on an extended Ritz method. Author (TAB)

N67-23937# General Technology Corp., Torrance, Calif.
STRESS ANALYSIS OF TWO INTERSECTING CYLINDRICAL SHELLS Quarterly Progress Report, Oct. 10, 1966
10 Oct. 1966 4 p
(Contract NObs-94173)
(AD-646389) CFSTI: HC $3.00/MF $0.65

Contents: Internal pressure case; Out-of-plane moment loading; In-plane moment loading. TAB

N67-24003# Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Materials Lab.
MECHANICS OF COMPOSITE MATERIALS. PART I: INTRODUCTION
Stephen W. Tsai Jun. 1966 48 p
(AFML-TR-66-149; Pt. I; AD-645073) CFSTI: HC $3.00/MF $0.65

The principles of mechanics are utilized for the description of the behavior of fiber-reinforced composites. Principal components of elastic moduli and strength for an orthotropic material are established as the intrinsic macromechanical properties. Micromechanics analyses provide a rational design basis of these properties from the material and geometric properties of the constituent materials. A bridge between the properties of the constituent materials and the structural behavior of a laminated anisotropic composite can then be established. Combined materials and structural design become feasible. Finally, test methods of composite materials are evaluated. The principles of mechanics can be used to select the material properties to be tested and the appropriate test procedures to be followed. Author (TAB)

N67-24006# General Dynamics/Convair, San Diego, Calif.
THE SUBCAVITATING HYDROFOIL (HYSTAD) PROGRAM, PHASE I Final Technical Report
1 Jun. 1966 105 p Addendum
(Contract NObs-90430)
(GDC-66-075-2; AD-646033) CFSTI: HC $3.00/MF $0.65

A series of four digital computer programs was used to facilitate the analysis of longitudinal mode stability of a given hydrofoil craft design. These programs have been modified for use on the BUSHIPS IBM 1620 Digital Computer. Craft physical data are converted into weight, center of gravity, and moment-of-inertia information; coefficients of the linearized equations of motion are generated; and finally the poles and zeroes of the open loop transfer function are produced. An option in one of the programs will provide potentiometer settings for an analog representation, if desired. The programs are identified as: HY1001, A Weight, Center of Gravity, and Inertia Data Computing Program; HY2A01, A Hydrofoil Craft Longitudinal Trim-Load Computing Program; HY2B01, A Hydrofoil Craft Longitudinal (2-DOF) Stability Derivative Computing Program; HY3001, A Program for Computing the Longitudinal Open Loop Transfer Function (2-DOF) of a Hydrofoil Craft. Author (TAB)

N67-24007# Battelle Memorial Inst., Columbus, Ohio.
EXPERIMENTAL DETERMINATION OF PLASTIC CONSTRAINT AHEAD OF A SHARP CRACK UNDER PLANE-STRAIN CONDITIONS
G. T. Hahn and A. R. Rosenfield Washington, Ship Struct. Comm., Dec. 1966 26 p refs
(Contract NObs-92383)
(SSC-180; PR-4; AD-646034) CFSTI: HC $3.00/MF $0.65

An experimental method of identifying the plastic constraint ahead of a sharp crack loaded under plane-strain conditions is proposed. The method is based on the idea that the cleavage stress-which can be measured with unnotched bars--is the peak stress developed ahead of a crack just prior to crack extension. Ways of calculating the strain, strain rate, and yield stress appropriate for the plastic region just ahead of the crack are developed. The ratio of the cleavage stress to the local yield stress identifies the plastic constraint factor at the stress level corresponding to crack extension. Experimental results recently reported by Krafft are shown to be consistent with this interpretation. With these data, the following expression for p.c.f., the plastic constraint factor, is deduced: p.c.f. = 1 + 2K/Y, where Y is the yield stress, K the stress intensity parameter, and the numerical constant, 2, has the dimensions inches to the -1/2 power. This result offers a way of formulating K sub/Ic, the fracture toughness for crack extension by cleavage, in more basic terms and sheds some light on the metallurgical origins of K sub/Ic. Author (TAB)

N67-24143 Polish Academy of Sciences, Warsaw. Institute of Basic Technical Problems.
PARAMETRIC SELF-EXCITED VIBRATION OF A PLATE OF FINITE LENGTH IN PLANE SUPERSONIC FLOW
Z. Dzygadlo *In its* Proc. of Vibration Probl., Vol. 7, No. 4 1966 p 287–309 refs (See N67-24141 12-23)

An analysis is made of parametric self-excited vibrations of plates of finite length in plane supersonic flow using the complete and simplified linearized theory of potential flow and assuming that the conditions of either hinged support or rigid support, or even elastic clamping are satisfied at the edges. Frequency equations are derived from which the boundaries of instability regions of the system are obtained in function of the Mach number of undisturbed flow. The convergence of the solution is studied. Computation was performed by digital computer and the results show the existence of a number of new effects connected with the action of parametric excitation on finite plates in supersonic flow. Author

N67-24144 Polish Academy of Sciences, Warsaw. Institute of Basic Technical Problems.
ON A CERTAIN CLASS OF CLOSED-FORM SOLUTIONS OF THE PROPAGATION PROBLEM OF ELASTIC-VISCO-PLASTIC WAVES IN NONHOMOGENEOUS BARS
E. Wlodarczyk *In its* Proc. of Vibration Probl., Vol. 7, No. 4 1966 p 311–327 refs (See N67-24141 12-23)

A method is proposed for obtaining closed form solutions of the propagation problem of stress waves in a nonhomogeneous elastic-visco-plastic medium, which presents vast possibilities of obtaining closed-form solutions of initial-boundary-value problems of the dynamic theory of plasticity. The problems considered are reflection problems of waves from various walls in elastic-visco-plastic bodies and the problem of wave diffraction at the boundaries of a stratified body. Author

N67-24147 Polish Academy of Sciences, Warsaw. Institute of Basic Technical Problems.

AERO-MAGNETO-FLUTTER OF A PLANE DUCT OF FINITE LENGTH

L. Solarz *In its* Proc. of Vibration Probl., Vol. 7, No. 4 1966 p 347–362 refs (See N67-24141 12-23)

Equations are obtained which describe the action of a flowing medium on the vibrating walls of a finite plane duct. On the basis of these equations, a method is proposed for computing the critical velocity. Programs were prepared which can be used to obtain diagrams of variability of the critical velocity as a function of the remaining parameters. Results show that the duct model can be used to appraise the influence of the magnetic field and the form of the vibration on the critical velocity, but not its magnitude. Resonance amplification of the action of the flowing medium may not occur in the model, which influences the aeromagneto flutter of the infinite duct. No simplification was introduced without estimating the resulting error, so that any confrontation of the results with those of experiment may enable an appraisal of the model's usefulness. R.N.A.

N67-24148 Polish Academy of Sciences, Warsaw. Institute of Basic Technical Problems.

SCATTERING OF RAYLEIGH WAVES AT A RANDOM BOUNDARY OF AN ELASTIC BODY

K. Sobczyk *In its* Proc. of Vibration Probl., Vol. 7, No. 4 1966 p 363–386 refs (See N67-24141 12-23)

The real surfaces of bodies can be best described by their statistical properties using a stochastic model of the surface. The problem of describing the boundary of a semi-infinite body consists of determining the statistical properties of the scattering field, the most important of which concern the damping of the Rayleigh wave and the velocity changes. The probabilistic characteristics of the parameters determining the damping of a Rayleigh wave and the variability of its velocity at the random boundary of an elastic body are determined. The considerations are embraced by the framework of the theory of random functions of the second order (the correlation theory). R.N.A.

N67-24311 France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.

VIBRATIONS OF A LAMELLATE STRUCTURE UNDER LOCALIZED EXTRUSION [VIBRATIONS D'UNE STRUCTURE LAMELLAIRE SOUS FLUAGE LOCALISE]

Robert Mazet 1963 31 p refs In FRENCH Presented at the Intern. Union of Theoret. and Appl. Mech. Symp. on Stress Waves in Elastic Solids, Providence, R. I., 3–5 Apr. 1963

(TP-12) CFSTI: $3.00

A hypothesis on stresses causing plastic deformation is considered in relation to a study of vibrations of laminated structures. Mathematical expressions are derived in defining the laminated structure, and internal forces of elastic state and plastic state are briefly evaluated. Equations of motion are solved for the general case specified. Application is made to loading conditions, and vibrations around localized flow. Transl. by R.Ll.

N67-24363# Army Materials Research Agency, Watertown, Mass.

ON THE NULLIFICATION OF STRESS CONCENTRATION FACTORS BY STRESS EQUALIZATION

Francis I. Baratta and Joseph I. Bluhm Nov. 1966 25 p

(AMRA-TR-66-37; AD-645625) CFSTI: HC $3.00/MF $0.65

A novel technique is presented for reducing the effective stress concentration factor in a typical tongue-and-groove compression joint employing dissimilar materials. Formulation and experimental verification for this technique are included. Author (TAB)

N67-24422*# Scientific Translation Service, La Canada, Calif.

TOWARD A GENERAL THEORY OF ELASTIC EQUILIBRIUM EQUATIONS FOR AN ISOTROPIC BODY [SAGGIO DI UNA TEORIA GENERALE DELLE EQUAZIONI DELL'EQUILIBRIO ELASTICO PER UN CORPO ISOTROPO]

Orazio Tedone Washington, NASA, Apr. 1967 45 p Transl. into ENGLISH from Ann. Mat., v. 8, no. 3, 1903 p 130–180 (Contract NASw-1496)

(NASA-TT-F-10796) CFSTI: HC $3.00/MF $0.65 CSCL 20K

Elastic equilibrium problems are formulated and solved in the form of definite integrals wherever possible. No mass forces are assumed. Problems in which the boundary forces and boundary displacements are specified as well as the general mixed boundary condition problems, are treated. Infinite planes and spheres are considered as boundaries. The problems reduce to ordinary or partial differential equations. Author

N67-24423*# Scientific Translation Service, La Canada, Calif.

TOWARD A GENERAL THEORY OF ELASTIC EQUILIBRIUM EQUATIONS FOR AN ISOTROPIC BODY

Orazio Tedone Washington, NASA, Apr. 1967 45 p refs Transl. into ENGLISH from Ann. Mat., v. 10, no. 3, 1904 p 13–64 (Contract NASw-1496)

(NASA-TT-F-10797 CFSTI: HC $3.00/MF $0.65 CSCL 20K

The elastic equilibrium problem for bodies limited by planes and spheres is treated using the theory of Green's functions and harmonic functions for the case of given stresses and displacements on the boundary, as well as for the mixed problem. Author

N67-24501*# National Aeronautics and Space Administration, Washington, D. C.

STRESS CONCENTRATION

G. N. Savin, ed. Apr. 1967 370 p refs Transl. into ENGLISH of the book "Kontsentratsiya Napryazheniy" Kiev, Izd. Naukova-Dumka, 1965 p 1–345

(NASA-TT-F-10736) CFSTI: HC $3.00/MF $0.65 CSCL 20K

Basic equations, experimental methods, and dynamic problems relating to stress concentration caused by various shapes and numbers of holes in shells, plates, and other structural bodies are reviewed in conference papers. For individual titles see N67-24502–N67-24545.

N67-24502*# National Aeronautics and Space Administration, Washington, D.C.

THE CONCENTRATION OF STRESSES AROUND CURVILINEAR HOLES IN PLATES AND SHELLS

G. N. Savin *In its* Stress Concentration Apr. 1967 p 3–38 refs (See N67-24501 12-32)

An overview is presented of problems related to stress concentration in structural bodies weakened by holes. A conformal mapping procedure is reported effective for determining the concentration of stresses around a curvilinear hole, and mapping procedures developed during the last several decades are reviewed in this light. Effect of material anisotropy, periodic problems and multiply-connected regions, and dynamic problems of stress concentration and of propagation of elastic waves from holes are discussed. Basic research studies are reviewed for elastic-plastic stress concentration around holes, and mention is made of a reverse problem in elasticity theory. Ring reinforcement in holes, and optimum ring configuration studies are reviewed. Consideration is given to nonlinear problems of stress concentration around holes in plates, the physically nonlinear and geometrically linear plane problem derivation, shells weakened by holes, and other aspects of stress concentration. M.W.R.

N67-24503*# National Aeronautics and Space Administration, Washington, D.C.
THEORY OF EQUILIBRIUM CRACKS IN AN ELASTIC LAYER
V. M. Aleksandrov *In its* Stress Concentration Apr. 1967 p 37–42 refs (See N67-24501 12-32)

Plane and three-dimensional problems of stable cracks in both elastic bands and elastic layers are investigated, with the assumptions that the cracks are located symmetrically with respect to the band edges and the relative band thickness is quite large. Boundary conditions on the band edges are given for three cases, and an integral equation is given to characterize the form of the crack. The axisymmetric case is also considered, and a formula is derived for the total stress acting on the crack edge. M.W.R.

N67-24504*# National Aeronautics and Space Administration, Washington, D.C.
LIMITING EQUILIBRIUM OF A PLATE WEAKENED BY A SYSTEM OF CRACKS SITUATED ALONG A STRAIGHT LINE AT AN ANGLE WITH RESPECT TO THE DIRECTION OF TENSILE FORCES
L. T. Berezhnitskiy *In its* Stress Concentration Apr. 1967 p 43–48 refs (See N67-24501 12-32)

Arbitrary crack orientation due to tensile stress is studied to shed light on the influence of defects on the supporting ability of brittle bodies. The limiting equilibrium state of an infinite elastic plate weakened by a series of aligned rectilinear cracks is considered, and it is assumed that the initial crack propagation direction coincides with the direction in which the normal tensile stress reaches a maximum intensity. Consideration is given to cases in which the infinite plate has two or three equal or unequal cracks, or when weakening is caused by a periodic system of slits. M.W.R.

N67-24505*# National Aeronautics and Space Administration, Washington, D.C.
BENDING OF A THIN ISOTROPIC PLATE WITH A HOLE OF GENERAL FORM, TAKING TEMPERATURE STRESSES INTO ACCOUNT
Ye. F. Burmistrov *In its* Stress Concentration Apr. 1967 p 49–54 refs (See N67-24501 12-32)

Elastic equilibrium is investigated in an isotropic plate of constant thickness that is located in a stationary thermal field in which the temperature changes linearly. Formulas are given for the bending moments, torques, and intersection forces, as well as for the general solution for bending due to temperature stresses. A rectangular thin isotropic plate with a hole is then considered in detail. Expressions are formulated for a plate with a center hole that is shaped like an ellipse or a regular polygon, and a table gives values for the moments for such cases. M.W.R.

N67-24506*# National Aeronautics and Space Administration, Washington, D.C.
STRESS CONCENTRATION AROUND A HOLE IN AN ELLIPSOIDAL SHELL OF REVOLUTION
V. N. Buyvol *In its* Stress Concentration Apr. 1967 p 55–59 refs (See N67-24501 12-32)

A shallow shell is considered that is weakened at the apex by a circular hole, and it is shown that the stress state of such an ellipsoidal shell of revolution may be solved by using equations for a spherical shell. The necessary formulations are presented, including the stress and moments corresponding to the stress and bending functions. It is suggested that, even for small eccentricity, the moments may have a significant influence on the bending stresses. M.W.R.

N67-24507*# National Aeronautics and Space Administration, Washington, D.C.
CONCENTRATION OF STRESSES IN GLASS-FIBER REINFORCED PLASTICS
G. A. Van Fo Fy *In its* Stress Concentration Apr. 1967 p 60–68 refs (See N67-24501 12-32)

Stress concentration around holes in glass-fiber reinforced plastics and other synthetic materials can be determined by finding the curvature of the hole profile or the surface body, the anisotropy and viscoelastic properties of the material, and the structural coefficient characterizing the stress distribution between the filler and the binder of the material. Thermoreactive polymers used in glass-fiber reinforced plastics are studied, and some experimental results and detailed formulations are presented. M.W.R.

N67-24508*# National Aeronautics and Space Administration, Washington, D.C.
ELASTOPLASTIC STATE NEAR A REINFORCED HOLE IN A SPHERICAL SHELL
V. V. Vasil'yev and I. S. Chernyshenko *In its* Stress Concentration Apr. 1967 p 69–72 refs (See N67-24501 12-32)

Stress and deformation states are investigated in the stress concentration zone around a circular hole in a spherical shell subjected to internal pressure. Near the hole, the shell becomes toroidal and is reinforced by a narrow elastic ring; and only vertical stresses are transmitted from the lid covering the hole to this ring. For solving beyond the elasticity limit of the shell, the theory of small elastoplastic deformations, the method of elastic solutions, and the method of finite differences are used. Differential equations describe the axisymmetric, elastoplastic state of the shell of revolution, and formulas are given for the constant meridian curvature and incompressibility of the shell material. Numerical results are presented in the form of curves showing the change in stress intensity for a range of internal pressures. Greatest stresses arise in the torus and ring cross sections, with the stress concentration in the spherical section somewhat smaller. M.W.R.

N67-24509*# National Aeronautics and Space Administration, Washington, D.C.
SLIP BANDS IN THIN PLATES WITH RECTILINEAR CUTS UNDER TENSION
P. M. Vitvitskiy *In its* Stress Concentration Apr. 1967 p 73–79 refs (See N67-24501 12-32)

An ideally elastic, isotropic, thin, infinite plate that has two equal narrow, rectilinear slits along the segments of its abscissa axis is studied under simple tension. Development of the first slip bands formed in the vicinity of the cut ends is found to be local in nature, and so the elastic-plastic equilibrium of the plate is considered as a problem of an elastic plate whose displacements undergo a discontinuity along specific lines. Details of the solution are included, and attention is given to a plate with only one slit. M.W.R.

N67-24510*# National Aeronautics and Space Administration, Washington, D.C.
PHOTOELASTIC INVESTIGATION OF STRESS CONCENTRATIONS NEAR A CIRCULAR HOLE IN A HYPERBOLIC SHELL
Yu. I. Vologzhaninov, V. I. Savchenko, and M. D. Fenchak *In its* Stress Concentration Apr. 1967 p 80–85 refs (See N67-24501 12-32)

Stress state is determined by a photoelastic method in a one-sheeted hyperboloid shell of revolution that is under axial compression, has constant thickness, and is weakened by a small circular hole. Pictures of the bands during the continuous radioscopy of a so-called frozen hyperboloid indicate that the disturbance of the stress state is localized. At distances both close to and far from the hole, the principal stresses change according to a linear law.

By comparing the stress state around the hole on the hyperboloid neck with the stress state of the plate loaded at infinity by forces equalling that of the principal stresses of the shell, approximate values of the force concentration can be obtained. M.W.R.

N67-24511*# National Aeronautics and Space Administration, Washington, D. C.
DETERMINATION OF STRESS CONCENTRATION ON THE BASIS OF APPLIED THEORY (ANNOTATION OF THE REPORT)
I. I. Vorovich and O. K. Aksentyan *In its* Stress Concentration Apr. 1967 p 86–87 ref (See N67-24501 12-32)

The possibility of employing the equations of applied theory for plate bending, based on the hypothesis of Kirchhoff, is considered for calculating stress concentration. A plate limited by a cylindrical surface Γ_1 and having a hole limited by a cylindrical surface Γ_2 is investigated. It is assumed that (1) the hole diameter and the distance between Γ_1 and Γ_2 are large as compared with the plate thickness, (2) the surface Γ_2 and the plane edges of the plate are free from stress, and (3) the surface Γ_1 Γ_1 loaded with a certain system of stresses. Author

N67-24512*# National Aeronautics and Space Administration, Washington, D. C.
HINGE-SUPPORTED AND FLEXIBLY CLAMPED SHALLOW SPHERICAL SHELL WITH A HOLE
S. P. Gavelya *In its* Stress Concentration Apr. 1967 p 88–91 refs (See N67-24501 12-32)

An approximate solution is derived for the elastic equilibrium of a shallow spherical shell with defined boundaries. Conditions of hinged clamping are satisfied in the rectilinear sections of the shell, and are somewhat simplified in the curvilinear section. A proposed solution, which reduces the elastic equilibrium equations to a system of integral equations, can be used for problems involving lack of symmetry, convergence of profiles, and shells with many holes. M.W.R.

N67-24513*# National Aeronautics and Space Administration, Washington, D. C.
HINGED CLAMPING OF A SHALLOW SPHERICAL SHELL BOUNDED BY AN ELLIPSE AND RECTANGLE
S. P. Gavelya and V. N. Kosarchin *In its* Stress Concentration Apr. 1967 p 92–96 refs (See N67-24501 12-32)

A system of differential equations is given for the elastic equilibrium of a hinge-clamped shallow spherical shell that is bounded by a rectangle and a curve with known parameters. Conditions for hinged clamping are set, and a solution is represented by a Green equation. The system of integral equations for the curvilinear section of the profile is reduced to a system of linear algebraic equations, and derivation of the final solution is detailed. M.W.R.

N67-24514*# National Aeronautics and Space Administration, Washington, D.C.
LIMITING EQUILIBRIUM OF A PLATE WEAKENED BY INTERNAL SHARP-POINTED NOTCHES
A. P. Gres'ko *In its* Stress Concentration Apr. 1967 p 97–103 refs (See N67-24501 12-32)

An infinite plate weakened by a hole in the form of a hypocycloid is investigated. Infinite stresses are applied that increase monotonically and are directed at a specified angle to the abscissa axis. Function mapping of the exterior region and boundary conditions are included for the main problem, and these are then given for an infinite plane with a notch in the form of a three-branched hypocycloid. Relationships are given for determining the coefficients of stress concentration and the stress in the vicinity of cuspoidal points. Determining the limiting equilibrium state of a plate with a hole in the form of an astroid is also considered, and the formula for finding the critical loading for each astroid apex is included. M.W.R.

N67-24515*# National Aeronautics and Space Administration, Washington, D. C.
INVESTIGATION OF THE STRESS STATE OF SPHERICAL SHELLS WITH MULTIPLY CONNECTED REGIONS
A. N. Guz' *In its* Stress Concentration Apr. 1967 p 104–112 refs (See N67-24501 12-32)

A method with specifically defined boundary conditions is proposed to study the stress state of shallow spherical shells with multiply connected regions. By controlling the accuracy with which these boundary conditions are satisfied, stress distributions can be found in the case when the holes in the shell converge. In the case investigated, there is a decrease in stress concentration along the center lines and an increase in the plate when the nonreinforced holes converge. M.W.R.

N67-24516*# National Aeronautics and Space Administration, Washington, D. C.
STRESS STATE OF A SPHERICAL SHELL WEAKENED BY TWO CURVILINEAR HOLES
A. N. Guz' and K. I. Shnerenko *In its* Stress Concentration Apr. 1967 p 113–117 refs (See N67-24501 12-32)

Equilibrium of a spherical shell weakened by two curvilinear holes is examined by an approximation method. The additional stress caused by the hole is determined by an integration under specific boundary conditions on the hole profiles, and the form for the boundary value problem is given. The formulation, which satisfies the conditions at infinity, permits the solution for a wide class of hole forms by appropriate selection of the mapping function. An examination is made of a shell loaded with internal pressures and weakened by both a circular and an elliptical hole, and the necessary stress equations are evolved. The influence of an elliptical hole upon the stress state around a circular hole is also investigated, and a table presents stress concentration coefficients for different values of the ellipse semiaxes. M.W.R.

N67-24517*# National Aeronautics and Space Administration, Washington, D. C.
FORMULATION OF STATIC BOUNDARY VALUE PROBLEMS FOR SHALLOW SHELLS FOR MULTIPLY CONNECTED REGIONS
V. I. Gulyayev and A. L. Sinyavskiy *In its* Stress Concentration Apr. 1967 p 118–122 refs (See N67-24501 12-32)

Attention is given to a multiply connected shell that is called an arbitrary orthogonal coordinate system, and formulas are evolved for the determination of boundary value problems for these shallow shells. The problem of determining the boundary conditions on the profile (or coordinate line) is reduced to finding the general integral of the differential equation. Three unknown constants, which correspond to three powers of static indeterminancy, are included in the composition of the boundary conditions for a system with a doubly connected region. Derivatives of stresses and deformations with respect to generalized forces are given, and the final set of equations is evolved. M.W.R.

N67-24518*# National Aeronautics and Space Administration, Washington, D. C.
CRITICAL LOAD FOR REGIONS WEAKENED BY HOLES AND CRACKS
A. A. Kaminskiy *In its* Stress Concentration Apr. 1967 p 123–129 refs (See N67-24501 12-32)

A procedure is evolved to determine the critical load for a thin, infinite plate that is weakened by an elliptical hole which causes two equal macroscopic equilibrium cracks. Uniaxial tension

is applied to the plate, and the hole is free from external loads. Boundary conditions for the stress functions are included, a conformal mapping function is introduced, and relationships are given for determination for the stress components. M.W.R.

N67-24519*# National Aeronautics and Space Administration, Washington, D. C.
TEMPERATURE STRESSES IN THIN PLATES WITH REINFORCED EDGES
Yu. M. Kolyano *In its* Stress Concentration Apr. 1967 p 130–137 refs (See N67-24501 12-32)

The heat exchange condition on the edge of thin plates reinforced by thin rings is discussed, along with the temperature field and temperature stresses in an infinite plate with a circular reinforced edge. An analysis is made of the temperature stresses of such an edge for a nonstationary thermal region, and graphs depict the stress distribution for a steel carbide plate reinforced by a thin bronze rod. M.W.R.

N67-24520*# National Aeronautics and Space Administration, Washington, D. C.
EFFECT OF CONCENTRATED FORCES IN MULTIPLY CONNECTED REGIONS
A. S. Kosmodamianskiy *In its* Stress Concentration Apr. 1967 p 138–144 refs (See N67-24501 12-32)

An elastic isotropic medium with two identical circular holes is studied, and concentrated forces are applied to the hole edges. Formulas are given for solutions with various stresses for cases with one and two holes. Tabular data indicate that the stress concentration sharply increases at the points between the holes and decreases at points where the hole edges are far from the points at which the concentrated forces are applied. M.W.R.

N67-24521*# National Aeronautics and Space Administration, Washington, D. C.
DESIGN OF SHELLS OF REVOLUTION WITH A SMALL HOLE AT THE APEX UNDER SYMMETRICAL AND ANTISYMMETRICAL LOAD
V. I. Kruglyakova *In its* Stress Concentration Apr. 1967 p 145–151 refs (See N67-24501 12-32)

Shells formed by the revolution of second order curves around their axes of symmetry are investigated, and it is shown that the symmetrical and asymmetrical loads for shells of revolution with small holes at their apex may be solved by the same procedure. Equations are given for determining the stresses and moments in both cases, and after arriving at a solution for the Bessel equation, formulas for the compliance coefficients are obtained. The solution was found to be within 5% of more accurate determinations. M.W.R.

N67-24522*# National Aeronautics and Space Administration, Washington, D. C.
PROPAGATION OF AN ELASTIC EXPANSION WAVE FROM A CIRCULAR HOLE IN A CYLINDRICALLY ANISOTROPIC, INHOMOGENEOUS PLATE
V. D. Kubenko *In its* Stress Concentration Apr. 1967 p 152–159 refs (See N67-24501 12-32)

Propagation of stress in a thin, infinite plate is studied when a constant pressure is applied to the edge of the circular hole suddenly. It is assumed that the plate material is cylindrically anisotropic; and the anisotropy axis coincides with the z-axis of the cylindrical coordinate system, and is continuously inhomogeneous so that the Young moduli are functions of a radial coordinate. The propagation of an equivoluminal wave in an isotropic medium with a shear modulus which changes over the radius according to a power law (plane deformation) is studied. There is a certain analogy between the present problem and that of an homogeneous isotropic material. The problem for a cylindrical cavity in an infinite medium of the above-mentioned type can be solved in the same way. Author

N67-24523*# National Aeronautics and Space Administration, Washington, D. C.
ONE CONDITION SUFFICIENT FOR THE EXISTENCE OF A SECONDARY LOAD PRODUCING ZERO MOMENT STATE IN A SHELL
P. I. Kudrik *In its* Stress Concentration Apr. 1967 p 160–164 refs (See N67-24501 12-32)

A shell is studied that has a positive curvature and a balanced force field applied to its middle. This field produces a stress state in the shell that differs from the zero moment state, and determination is made of a secondary load with a new force field that can also produce a zero moment stress in the shell. The solution is applicable to a wide variety of shells. After describing the method for solving the problem, an example of a spherical shell with circular hole and loaded by both surface and edge stresses is presented. The case when the spherical shell is weakened by an arbitrary curvilinear hole without corner points is also treated. M.W.R.

N67-24524*# National Aeronautics and Space Administration, Washington, D. C.
GENERALIZATION OF THE GRIFFITH-SNEDDON CRITERION TO THE CASE OF AN INHOMOGENEOUS ELASTIC BODY
V. I. Mossakovskiy and M. T. Rybka *In its* Stress Concentration Apr. 1967 p 165–172 refs (See N67-24501 12-32)

Based on concepts advanced by Griffith during an energy approach study of the formation and development of cracks in a brittle body, the criterion for the perturbation of an inhomogeneous elastic body is established. Two elastic halfspaces with different elastic properties are investigated, and a circular crack exists in the plane connecting the halfspaces. Tensile stresses, applied at infinity, are perpendicular to the crack plane. Boundary conditions are derived, and the axisymmetric problem is reduced to the plane problem. A solution is offered to the plane problem to determine the criterion of disturbance. Formulas are also given for determining the normal and shearing stresses outside the crack on the dividing plane. M.W.R.

N67-24525*# National Aeronautics and Space Administration, Washington, D. C.
STRESS STATE OF A PLANE WEAKENED BY A BROKEN-LINE CRACK
V. I. Mossakovskiy, P. A. Zagubizhenko, and P. Ye. Berkovich *In its* Stress Concentration Apr. 1967 p 173–177 refs (See N67-24501 12-32)

In order to determine the critical load for crack propagation due to tension forces that are not perpendicular to the crack axis, the stress distribution in the plane weakened by a broken-line crack must be found. The boundary conditions are given, and a local coordinate system oriented along the crack is introduced. Boundary conditions in the inclined sections are then expressed in terms of the stress components in the unprimed axes. Relationships concerning the crack edge are obtained, and mapping on a circle is employed in order to compute the stress at the crack edge. M.W.R.

N67-24526*# National Aeronautics and Space Administration, Washington, D. C.
PROPAGATION OF CRACKS OF A NEARLY CIRCULAR PLANAR FORM
V. V. Panasyuk *In its* Stress Concentration Apr. 1967 p 178–183 refs (See N67-24501 12-32)

An approximation method is developed for determining the critical load for an unlimited circular planar body weakened by an isolated crack. The body is assumed to be loaded by a monotonically increasing system of external stresses that are symmetrical to the crack plane. While the problem is reduced to one of determining the elastic stresses in the vicinity of the crack profile for a given load, the mathematical solution is considered to be difficult. The necessary equations and boundary conditions are given for finding the breaking load. M.W.R.

N67-24527*# National Aeronautics and Space Administration, Washington, D. C.
STUDY OF THE STRESS CONCENTRATION NEAR HOLES IN PLATES DURING BENDING
B. L. Pelekh *In its* Stress Concentration Apr. 1967 p 184–189 refs (See N67-24501 12-32)

Special plate theories are used to study stress concentration around holes in plates during bending, and the three natural boundary conditions on the hole profiles are satisfied. Stresses and moments are determined, expressions are given for the bending stresses, and simple solutions are included for several cases of homogeneous stress state of a finite rectangular plate. Two-sided bending and torsion moments are written for plate loading, and the corresponding solutions are given in polar coordinates. As an example, an examination is made of a rigid ring that is sealed into a circular hole of a plate. Investigations based on these special plate theories do not provide reliable results for very small holes. Even for holes which exceed plate thickness by a factor of 3, the error in the concentration coefficient is placed at 10%. M.W.R.

N67-24528*# National Aeronautics and Space Administration, Washington, D. C.
EFFECT OF FOREIGN MACROINCLUSIONS ON THE DISTRIBUTION OF TEMPERATURE FIELDS AND STRESSES IN ELASTIC BODIES
Ya. S. Podstrigach *In its* Stress Concentration Apr. 1967 p 190–200 refs (See N67-24501 12-32)

Temperature field and stress state are investigated for material nonuniformity caused by macroinclusions or cavities in structural elements. Particularly for cavities and holes, the temperature stresses caused by thermal flux disturbances must be considered when determining the stability of materials operating under nonuniform heating conditions. Specifically, problems related to the influence of elastic nonuniformities on the distribution of temperature fields and stresses in elastic bodies are treated, and various references are made to previously conducted studies on thermal stresses and thermoconductivity. Relationships are given for solutions for a class of plane problems in nonstationary thermal regimes for both a plane and a generalized plane temperature. The computational model assumes that the thickness of the transitional layer is small compared with the other dimensions, and conditions of physico-mechanical contact are considered. M.W.R.

N67-24529*# National Aeronautics and Space Administration, Washington, D. C.
EFFECT OF A DIFFUSION PROCESS ON THE STRESS CONCENTRATION NEAR A CIRCULAR HOLE
Ya. S. Podstrigach and V. S. Pavlina *In its* Stress Concentration Apr. 1967 p 201–205 refs (See N67-24501 12-32)

A system of differential equations is obtained that reflects the interrelationship between the processes of deformation, diffusion, and thermoconductivity; and this system permits the study of the influence of diffusion produced by a nonuniform stress state upon change in time of stress concentration around the holes in a body. Equations at a constant temperature are first solved, polar coordinates are introduced, boundary conditions for the stresses are given, an inverse Laplace transformation is performed, and the stresses influencing the body are obtained. Detailed mathematical formulations are presented, and the problem is then considered in terms of the change with time of the solute concentration and the stresses. The approximations given indicate that, in most extended zones the solute concentration, increases or decreases with time according to corresponding changes in the coefficient of linear expansion, although effective stresses always appear to decrease. M.W.R.

N67-24530*# National Aeronautics and Space Administration, Washington, D. C.
PROPAGATION OF ELASTIC WAVES ALONG A CYLINDRICAL CAVITY FILLED WITH A CONDUCTING FLUID
I. T. Selezov *In its* Stress Concentration Apr. 1967 p 206–212 refs (See N67-24501 12-32)

The magnetohydroelasticity problem of axisymmetric waves in an elastic body-conductive liquid system is considered. A cylindrical cavity having a circular transverse cross-section, filled with a nonviscous, compressible conductive liquid, exists in an elastic body having infinite dimensions. A uniform constant magnetic field is applied along the cavity axis, and it is assumed that the elastic body is magnetically and electrically neutral. In essence, this system represents a waveguide having an unusual characteristics and is important for geophysical research. Author

N67-24531*# National Aeronautics and Space Administration, Washington, D. C.
A CASE OF DYNAMIC STRESSES IN AN UNBOUNDED ELASTIC SPACE WITH A CYLINDRICAL CAVITY
M. M. Sidlyar *In its* Stress Concentration Apr. 1967 p 213–217 refs (See N67-24501 12-32)

The dynamic problem of stresses in unbounded space with a circular cylindrical cavity having the radius $r_0 = 1$ is studied. These stresses are produced by the influence of force sources which change harmonically with time and which are uniformly distributed in two planes that are parallel to the cylinder axis. In particular, the stress state around the cavity is analyzed. Author

N67-24532*# National Aeronautics and Space Administration, Washington, D. C.
CONCENTRATION OF MOMENTS AT HOLES IN THE BENDING OF THIN PLATES WITH ALLOWANCE FOR PHYSICAL NONLINEARITY
A. V. Stepanov *In its* Stress Concentration Apr. 1967 p 218–227 refs (See N67-24501 12-32)

Small deflection bending is investigated in thin plates whose material follows a nonlinear law of elasticity. A solution is given for the moment concentration in a circular plate that is loaded axisymmetrically as well as for a thin rectangular plate that is weakened by a circular hole and subjected to pure cylindrical bending. Influence of external loading and elastic properties of the material upon the moment concentration coefficient is investigated. Fundamental bending equations and their method of solution are given for a thin plate, with the study is confined to cases where there is a small deviation of the nonlinear elasticity law from Hooke's law. Details are given for the circular plate that has a hinge-supported outer edge subjected to a uniformly distributed moment. Concentration coefficients and bending moments are shown for the rectangular plate that is weakened by a hole, and curves are included for copper and open-hearth steel plates. M.W.R.

N67-24533*# National Aeronautics and Space Administration, Washington, D. C.
STRESS CONCENTRATION NEAR CAVITIES IN AN INCOMPRESSIBLE MATERIAL
G. S. Tares'yev and L. A. Tolokonnikov *In its* Stress Concentration Apr. 1967 p 228–232 refs (See N67-24501 12-32)

The first two terms of a stress series are calculated for stress concentration near cavities in an incompressible material, and the solution is reduced to the successive determination of the biharmonic functions according to the boundary values on the region profile and at infinity. Holomorphic functions are determined for an elliptical cavity and for a cavity that is almost a square, and calculated stresses on individual points are graphed for the former and tabulated for the latter. M.W.R.

N67-24534*# National Aeronautics and Space Administration, Washington, D. C.
BENDING OF REINFORCED PLATES
V. I. Tul'chiy *In its* Stress Concentration Apr. 1967 p 233–238 refs (See N67-24501 12-32)

Fundamental boundary relationships are introduced for the theory of reinforced plate bending; and applications are discussed for an isotropic plate with ring reinforcement, for cylindrical bending of an infinite plate, and for an anisotropic plate with an elliptical hole. Ring reinforcement is shown to reduce the stress concentration coefficient in the area of the hole by a factor of more than two. Mention is made of the testing of an infinite plate. M.W.R.

N67-24535*# National Aeronautics and Space Administration, Washington, D. C.
A METHOD OF DETERMINING THE STRESS CONCENTRATION AT "NODAL POINTS"
A. G. Ugodchikov *In its* Stress Concentration Apr. 1967 p 239–244 refs (See N67-24501 12-32)

A conformal mapping procedure that employs an interpolation of Lagrange polynomials in the complex region is used to determine stress concentration at nodal points in structural elements, and electronic computers make the actual calculations. The method of finite differences or p-transformations is used to solve the plane problem for an elastic medium occupying a certain region for which the external stresses are given. Boundary conditions are set, and the procedure is developed to yield a final solution. A graph indicates stress at points of the radial transition boundary. M.W.R.

N67-24536*# National Aeronautics and Space Administration, Washington, D. C.
SOLUTION OF SEVERAL PROBLEMS FOR DOUBLY CONNECTED REGIONS WITH CONTIGUOUS CIRCULAR BOUNDARIES
Yu. A. Ustinov *In its* Stress Concentration Apr. 1967 p 245–249 refs (See N67-24501 12-32)

A method is presented to solve certain problems for doubly-connected regions with circular boundaries, which are located close to each other. Stress state is determined for an eccentric ring pulled along the line of symmetry by two concentrated forces applied from the outer profile. The region occupied by the ring is related to a bipolar coordinate system, and a transformation of the series is performed. Limitations of the results are noted, and appropriate steps are indicated to improve the calculation for a half-plane with a circular hole when a concentrated force is applied to the rectilinear boundary above the connector. Two specific problems are treated, namely the extension of a half-plane with a circular hole and the extension of a plane with two equal circular holes. These solutions are not considered valid if the ratio of connector thickness to hole radius is small. M.W.R.

N67-24537*# National Aeronautics and Space Administration, Washington, D. C.
NUMERICAL METHOD FOR CONFORMAL MAPPING OF SIMPLY AND MULTIPLY CONNECTED REGIONS, BASED ON TRIGONOMETRIC INTERPOLATION
P. F. Fil'chakov *In its* Stress Concentration Apr. 1967 p 250–260 refs (See N67-24501 12-32)

A trigonometric interpolation is used for conformal mapping of a simply-connected region that is bound by a closed profile. The orthogonality conditions of the trigonometric functions are considered important in the case of equally spaced data. An iteration process is used to determine the nodal points to within a predetermined accuracy, and two systems of nodal points are considered. By obtaining formulas for even and odd nodal points, the iteration process is simplified. The described method can be generalized for external and doubly-connected regions. Another method for making these determinations is also formulated, and is considered to yield particularly good results with an underwater wing in a shoal that has a bottom of arbitrary form. M.W.R.

N67-24538*# National Aeronautics and Space Administration, Washington, D. C.
COMPLETE ELIMINATION OF STRESS CONCENTRATIONS AROUND HOLES IN PLATES
N. P. Fleyshman and B. L. Pelekh *In its* Stress Concentration Apr. 1967 p 261–265 refs (See N67-24501 12-32)

The elimination of stress concentration during the design of laminated objects with holes is discussed in terms of the use of reinforcement rings. A system of differential equations of plate bending is used to solve the boundary value problem, and ring selection is treated mathematically for given loadings and deformations. Variations due to plate bending are given, and expressions for rigidity in bending and twisting of a reinforced circular rod are evolved. M.W.R.

N67-24539*# National Aeronautics and Space Administration, Washington, D. C.
EFFECT OF A STEADY THERMAL FIELD ON THE STRESS CONCENTRATION IN AN INFINITE ELASTIC PLANE WITH CIRCULAR HOLE
V. L. Fomin *In its* Stress Concentration Apr. 1967 p 266–269 ref (See N67-24501 12-32)

Stress state is investigated for an infinite elastic plane with a circular hole that is subjected to a steady thermal field and satisfies both conditions of boundedness at infinity and the boundary conditions on the hole profile. It is assumed that there are no external stresses on the profile, and that the stresses at infinity equal zero, and the Muskhelishvili analogy between temperature and dislocation stresses is used in the solution. Means of introducing the stress concentration coefficient on the hole profile are presented, as is an equality for expressing the condition of no plastic flow on the profile. M.W.R.

N67-24540*# National Aeronautics and Space Administration, Washington, D. C.
EFFECT OF THE CREEP PROPERTIES OF THE MATERIAL ON THE STRESS CONCENTRATION AROUND A CIRCULAR HOLE IN A PLATE
L. P. Khoroshun *In its* Stress Concentration Apr. 1967 p 270–274 refs (See N67-24501 12-32)

Stress state of a plate with a circular hole is studied on the basis of the nonlinear flow theory of steady creep. The problem is solved by the method of successive approximations. The biaxial stress state of a plate and the particular cases following from this solution are investigated. Author

N67-24541*# National Aeronautics and Space Administration, Washington, D. C.
PHYSICALLY NONLINEAR ELASTIC PLATES WEAKENED BY AN ARBITRARY HOLE
I. A. Tsurpal *In its* Stress Concentration Apr. 1967 p 275–280 refs (See N67-24501 12-32)

Stress state is investigated around a square hole with reinforced corners in an elastic plate, and, nonlinear dependence between stresses and deformations are determined. An unbounded, nonlinear isotropic plate under unidirectional, uniform stresses at infinity is studied, and the stress components are found in the curvilinear orthogonal coordinate system. Tables present concentration coefficient values over the hole profile from both linear and nonlinear theory. The concentration coefficient is shown to depend upon the elastic properties of the material, the magnitude of the external load, and the nature of the mapping function used. M.W.R.

N67-24542*# National Aeronautics and Space Administration, Washington, D. C.

DETERMINATION OF THE STRESS CONCENTRATION NEAR A HOLE IN A SHELL--IN THE LINEAR FORMULATION

K. F. Chernykh *In its* Stress Concentration Apr. 1967 p 281-286 refs (See N67-24501 12-32)

Theoretical considerations related to determining stress concentration caused by holes in shells are discussed in terms of linear formulations. Attention is given to solutions for cases of punctures or small holes that can be easily reinforced and to circular holes in various shape shells. Use of isothermal coordinates related to conformal mapping, a system of static functions, and other techniques are summarized. Rigidity, boundary conditions, various geometric conditions, and elastic coupling are mentioned; and stress concentration problems that require solutions are noted. M.W.R.

N67-24543*# National Aeronautics and Space Administration, Washington, D. C.

DYNAMIC STRESSES IN A THIN THERMOELASTIC PLATE WEAKENED BY A CIRCULAR HOLE

R. N. Shvets *In its* Stress Concentration Apr. 1967 p 287-293 refs (See N67-24501 12-32)

Steady stress state and temperature field are determined around a circular hole in a thermoelastic plate. The influence of concentrated force, which is periodic in time at a certain point on the surface of the plate, is found. The deformations and the stresses produced by these forces are propagated in the plate in an undulating manner with a finite velocity. Allowance for scattering of mechanical energy in thermoelasticity equations leads to damping of these waves as they recede from the center. The problem is solved in the linear formulation and under the assumption that the wavelength is large as compared with the plate thickness. Author

N67-24544*# National Aeronautics and Space Administration, Washington, D. C.

INFLUENCE OF CONCENTRATED EFFECTS ON SHALLOW SHELLS

Yu. A. Shevlyakov and V. P. Shevchenko *In its* Stress Concentration Apr. 1967 p 294-303 refs (See N67-24501 12-32)

A two-dimensional integral Fourier transformation and the theory of generalized functions are used to obtain a system of differential equilibrium equations to determine the influence of concentrated bending and tangential forces on shallow shells of constant curvature. The solution is shown to have a closed form for spherical and cylindrical shallow shells. Formulation of the equilibrium equations is detailed, and modifications are included for the two types of shells and for a rectangular plate. M.W.R.

N67-24545*# National Aeronautics and Space Administration, Washington, D. C.

INVESTIGATION OF THE BRITTLE FRACTURE OF SAMPLES WITH STRESS CONCENTRATORS

S. Ya. Yarema, and L. V. Ratych *In its* Stress Concentration Apr. 1967 p 304-308 refs (See N67-24501 12-32)

The influence of stress concentration on the supporting capacity of structural elements made of brittle microscopically nonuniform materials is studied using a sample of gray pig iron with graphite inclusions. Strength under tension is discussed for both plates with circular holes and bands with hyperbolic cuts; and it is concluded that nonuniformity of structure is the most important factor in determining strength. Comparison of mechanical and metallographic research shows that the coarser the structure, the larger the structural strength parameter and the smaller the influence of artificial stress concentrators. M.W.R.

N67-24649# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

TEMPERATURE STRESSES IN A THIN ELASTIC PLATE WITH THE PRESENCE OF A SOURCE OF HEAT ON THE CONTOUR OF THE PLATE

V. R. Kul'bakh 7 Dec. 1966 19 p refs Transl. into ENGLISH from Tr. Politekhnicheskiy Inst. (Tallinn), no. 200, 1963 p 49-61 (FTD-HT-66-367; TT-67-60990; AD-646928) CFSTI: HC$3.00/MF$0.65

The stressed state of a thin rectangular plate whose contour is acted upon by a heat source is considered. The relative temperature problem is solved and the temperature stresses are determined. The solutions obtained are analyzed and as an example of determining the temperature stresses is examined. Author (TAB)

N67-24711# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THERMAL STRESSES IN SHELLS OF ROTATION AT A NONAXIALLYSYMMETRICAL TEMPERATURE FIELD

D. Kh. Krakovskiy 18 Aug. 1966 15 p refs Transl. into ENGLISH from Nauchn. Soveshch. po Teplovym Napryazh. v Elementakh Konstrukt., Dokl. Nauk. Dumka (Kiev), no. 4, 1964 p 113-121

(FTD-TT-65-2044; AD-646450) CFSTI: HC$3.00/MF$0.65

Equations are developed for the thermal stresses. TAB

N67-24713# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

A NONSTATIONARY TEMPERATURE PROBLEM FOR A CYLINDRICAL SHELL REINFORCED BY A RING

S. M. Durgar'yan 18 Aug. 1966 17 p refs Transl. into ENGLISH from Tr. Vses. Kongerentsiya po Teorii Plastin i Obolochek, 2D, LVOV, 1961 (USSR), 1964 p 452-460

(FTD-TT-65-2041; AD-646387) CFSTI: HC$3.00/MF$0.65

The report is devoted to the study of stressed and deformed states of thin-walled, reinforced cylindrical shells with changing temperatures. TAB

N67-24716# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

FLUTTER PLATES SITUATED IN THE FIELD OF TEMPERATURE ACTION

S. A. Ambartsumyan and G. Ye. Bagdasaryan 29 Jul. 1966 13 p refs Transl. into ENGLISH from Dokl. Akad. Nauk. ArmSSR, v. 39, no. 3, 1964 p 141-147

(FTD-TT-65-2005; AD-646384) CFSTI: HC$3.00/MF$0.65

The critical velocity of flutter is determined mathematically. TAB

N67-24788# Monsanto Research Corp., Dayton, Ohio.

FOAM GENERATOR SYSTEM TO INFLATE THE PK-2 LIFE RAFT Final Report

I. O. Salyer, J. L. Schwendeman, and C. E. McClung Jan. 1967 97 p

(Contract N178-8823)

(AD-647373) CFSTI: HC$3.00/MF$0.65

Four possible approaches were investigated to determine which approach most closely met the Navy's performance specifications for deploying and inflating the PK-2 life raft. The four approaches investigated were: Use preformed flexible foam as a means for deploying and inflating the raft. Use two-component liquid polyurethane reactants in conjunction with simplified mixing equipment to produce semi-rigid foam-inflating material. Use solid-reactant urethane foam ingredients disposed on a suitable substrate in combination with a pyrotechnic heating device to initiate the foam reaction. Use foams from polymers dissolved in liquified gases; these foams are produced by venting the components from a pressurized container. Each of these approaches showed some degree of feasibility. However, some of the approaches are further advanced toward practicality or are more suitable for life raft requirements than are others. Each approach is treated as a separate entity since there is little or no dependence or relationship of one approach to another. TAB

N67-24770# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE EQUATIONS OF BENDING OSCILLATIONS OF A CAVITY THAT IS PARTIALLY FILLED WITH FLUID

L. V. Dokuchayev 16 Sep. 1966 13 p refs Transl. into ENGLISH from Akad. Nauk SSSR Izv. Mekhan. (Moscow), no. 3, 1965 p 149–153

(FTD-HT-66-471; TT-65-14435; AD-646431) CFSTI: HC $3.00/MF $0.65

Equations are generalized for the case of a noncylindrical rod with a fluid partially filling a cavity of arbitrary configuration, and the coefficients of these equations are also determined for the case of a conic shell with a small apex angle. Author (TAB)

N67-24773# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CALCULATION OF THE STRENGTH OF METALLIC AND PLASTIC CYLINDRICAL VESSELS, REINFORCED BY A WIND OF HIGH-STRENGTH MATERIAL

A. V. Amel'yanchik 9 Sep. 1966 34 p refs Transl. into ENGLISH from Prochnost i Dinam. Aviats. Avigateley. Sb. Statey (Moscow), no. 1, 1964 p 3–22

(FTD-MT-65-154; TT-67-60777; AD-646420) CFSTI: HC $3.00/MF $0.65

Two cases of calculation of strength in reference to glass plastic vessels are analyzed. The method allowing determination of interesting magnitudes by selection (trial and error method) is discussed. It is shown that for analysis of the strained condition of cylindrical vessels from glass plastics, it is possible to apply the same treatment as when investigating metallic vessels with winding. The following cases are considered: (1) a vessel with strained winding at an angle to the generatrix; (2) a glass plastic vessel. TAB

N67-24787# Picatinny Arsenal, Dover, N. J. Engineering Sciences Lab.

SOLUTION OF THE EQUATION OF MOTION FOR FORCED TRANSVERSE VIBRATION OF A SLENDER BEAM WITH VISCOUS DAMPING

William B. Deem Jan. 1967 45 p refs

(PA-TR-3490; AD-646633) CFSTI: HC $3.00/MF $0.65

The equation of motion for the forced transverse vibration of a slender elastic beam with viscous damping is programmed for computer solution. The method of variation of parameters is used in the numerical solution of the equation of motion, giving the deflections due to each transverse mode of vibration. Stresses within the beam can be calculated in order to verify its structural integrity. The report is published to provide a handy and detailed solution to the forced vibration problem; however no priority in method of solution is claimed. The computer program is written in FORTRAN H for use on any IBM 360 computer. Author (TAB)

N67-24792# California Univ., Berkeley. Div. of Applied Mechanics.

SMALL MOTIONS SUPERPOSED ON LARGE STATIC DEFORMATIONS IN POROUS MEDIA

M. J. Crochet and P. M. Naghdi Oct. 1966 48 p refs

(Contract Nonr-222(69)

(AM-66-18; AD-646910) CFSTI: HC $3.00/MF $0.65

The paper is concerned with the development of the field equations and constitutive equations for small motions superposed on large static deformation of a liquid-filled porous elastic solid, using a basic theory of interacting continua. Two examples of parallel flow in a medium which initially is subjected to a homogeneous deformation is discussed. Also a representation for the solutions of the equations of the infinitesimal theory (analogous to the Boussinesq-Papkovitch representation) is deduced for a class of steady flow. Author (TAB)

N67-24805# Giannini Controls Corp., Malvern, Pa. Astromechanics Research Div.

STIFFNESS DESCRIBER OF CONICAL AND HEMISPHERICAL FILAMENT WOUND STRUCTURES

Jacob M. Miller Sep. 1966 51 p refs

(Contract AF 49(638)-1509)

(AFOSR-66-1944; AD-646595) CFSTI: HC $3.00/MF $0.65

The report presents a technique for determining the Stiffness Describer for conical and hemi-spherical filament wound structures. The expressions that were derived are extensions of the expressions presented in AFOSR Scientific Report 65-2214 (AD-626 226), which was restricted to cylindrical filament wound structures. The Describer, portrayed herein, uses the same mathematical modeling of filament wound structures and shell strain energy expressions as the previous report. The departure from the previous report came in relating the radii to the axial dimensions prior to integrating the strain energy expression. (The previously reported expressions for a cylinder had a constant radius, regardless of axial dimensions.) The technique described in this, and the preceding report, provides the dynamicist with means to analyze filament wound structures composed of cylinders, cones, and hemi-spheres. The data that is needed in order to use these expressions are physical properties such as: Poissons Ratio, Moduli of Elasticity and Rigidity for the filament and resin, winding angles of plies, geometric data such as length, base radius, over-all thickness, and cone angle. Author (TAB)

N67-24819# Allied Research Associates, Inc., Concord, Mass.

STRUCTURAL GUIDELINES FOR MATERIALS DEVELOPMENT. PART III: GUIDELINES FOR TENSION AND COMPRESSION STRUCTURES Final Report

H. Becker Feb. 1967 55 p refs

(Contract NOw-65-0595-F)

(ARA-304-7; AD-646809) CFSTI: HC $3.00/MF $0.65

By means of an examination of the sensitivity of structural efficiency to mechanical properties of materials, broad evaluations are generated which may serve as structural guidelines for materials development. Results are presented for tension structures under static loading and in fatigue, and for compression structures. Effects of temperature are considered. For evaluation of tension structures, the use of the ductility ratio concept was found to be fruitful. In addition to providing data on structural strength, it also appears to provide an engineering approach to evaluation of material strength under static loading, and to act as a springboard for assessing the sensitivity of materials to fatigue. The sensitivity of compression structures was investigated through the use of results from minimum weight analysis in which weight/strength ratio is expressible in terms of material parameters and the structural design index. Author (TAB)

N67-24865# RAND Corp., Santa Monica, Calif.

COUPLING EFFECTS ON THE DYNAMIC STABILITY OF THIN SHELLS

T. C. Fan and L. M. Lackman (Southern Calif. Univ.) Feb. 1967 19 p refs Presented at the 5th U. S. Natl. Congress of Appl. Mech., Minneapolis, 14–17 Jun. 1966
(P-3539; AD-647689) CFSTI: HC $3.00/MF $0.65

Equations are developed for determining the equivalent thermal stress problem. TAB

N67-24921# Midwest Research Inst., Kansas City, Mo.
AN EXPERIMENTAL STUDY ON THE AEROELASTIC STABILITY OF THIN CYLINDRICAL SHELLS AT THE LOWER SUPERSONIC MACH NUMBERS
Ronald O. Stearman Dec. 1966 93 p refs
(Contracts AF 49(638)-1472; AF 33(615)-1740)
(AFOSR-66-2828; ARL-67-0006; AD-647748) CFSTI: HC $3.00/MF $0.65

During the initial phases of the test static pressure and boundary layer profile surveys were made over a rigid instrumented shell mounted in the position normally occupied by the flutter shells. The model boundary layer control system was also checked. In the final test phase the aeroelastic stability of five thin shells was investigated with the shells loaded under an axial compressive force and/or internal pressure. A highly divergent panel flutter instability occurred on all of the models tested, each shell being destroyed within less than a second. High speed motion pictures were taken during the flutter of three of the shells. These pictures revealed that the initial instability appeared either in the form of a local dimple or in the form of a wave traveling in the free stream direction. The characteristic wave lengths of these initial instabilities were small compared to the shell radius and length. A comparison of the present experimental results with some earlier studies conducted at the higher supersonic Mach numbers indicates that the critical ratio of dynamic pressure to bending stiffness required to induce flutter is approximately three times that found at the higher Mach numbers. Considerable disagreement was also observed between these experimental results and the results of two different theoretical analyses. Author (TAB)

N67-24937# Michigan Univ., Ann Arbor. Dept. of Electrical Engineering.
ATTENUATION OF SOUND BY SPHERICAL SHELLS Final Report
Norman E. Barnett Oct. 1966 78 p refs
(Contract Nonr-1224(24))
(Rept.-2784-9-F; AD-646911) CFSTI: HC $3.00/MF $0.65

The study of acoustic attenuation at low frequencies by thin spherical shells was continued beyond the initial analysis by Goodman and Stern (J. Acoust. Soc. Am., 34:338, 1962). Experimental measurements were conducted both in air and in water. Numerical evaluation was extended to include the first-order coefficient. For metallic shells immersed in either air or water, the first-order coefficient is larger than, and exhibits interesting fluctuations at lower frequencies than, the zeroth-order coefficient. As a practical consequence, pure zeroth-order behavior is difficult to observe even in the laboratory and most measurements exhibit the combined effects from several orders. Author (TAB)

N67-24959# Lehigh Univ., Bethlehem, Pa. Dept. of Applied Mechanics.
SOME THREE-DIMENSIONAL INCLUSION PROBLEMS IN ELASTICITY
M. K. Kassir and G. C. Sih Dec. 1966 37 p refs
(Contract Nonr-610(06))
(TR-5; AD-647240) CFSTI: HC $3.00/MF $0.65

The theory of potential functions is applied to solve a number of three-dimensional problems involving sheet-like inclusions embedded in elastic solids. Two types of inclusion are considered: namely, that of a rigid elliptical disk and a rigid sheet containing an elliptical hole. By varying the ellipticity of the disk and hole, certain information on the general character of the stresses around a plane inclusion of arbitrary shape may be obtained. More precisely, if reference is made to a suitable coordinate system, the functional forms of the stresses in the close neighborhood of the inclusion border can be expressed independently of uncertainties of both the inclusion geometry and of the applied stresses or displacements. In general, the intensification of the local stresses can be described by three parameters which may be used to establish criteria for the failure of the solid containing the inclusions. Author (TAB)

N67-24997# Columbia Univ., New York. Dept. of Civil Engineering and Engineering Mechanics.
INFLUENCE DIAGRAMS FOR STRESSES AND DISPLACEMENTS IN THREE-LAYER PAVEMENT SYSTEMS FOR AIRFIELDS, PART II
Donald M. Burmister Dec. 1966 93 p refs
(Contract NBy-13009)
(TR-2; AD-646986) CFSTI: HC $3.00/MF $0.65

The report presents influence diagrams for vertical stresses, shear stresses, and surface deflections in three-layer pavement systems, which are intended to provide the essential background and bases for evaluating the character and effectiveness of layered system reinforcing action. The vertical stress and shear stress transmission characteristics and critical regions, and the surface deflection performances are developed for nine three-layer concrete pavement systems for a range of layer modulii ratios; and ratios of layer 2 to layer 1 thickness. The effectiveness of reinforcing action, deflection performances, and shear stress performances in critical regions are treated and compared. Two-layer and three-layer thickness and layer modulii equivalences are developed and treated to illustrate methods for evaluating and for improving shear stress and deflection performance by modifications of layer modulii ratios and layer thicknesses. The major objectives are to develop a 'feeling', intuition, and judgments regarding deflection and shear stress performances of layered pavements, and to develop relationship and methods for evaluating layer thickness and modulii ratios, and criteria for rational and effective design for multilayer pavement system for airfields and for ensuring satisfactory pavement performances and long life. Author (TAB)

N67-25001* National Aeronautics and Space Administration, Washington, D. C.
SOLUTION OF THE BASIC BIHARMONIC PROBLEM FOR A WIDE CLASS OF REGIONS BY THE METHOD OF SUMMARY REPRESENTATIONS [RESHENIYE OSNOVNOY BIGARMONICHESKOY ZADACHI DLYA SHIROKOGO KLASSA OBLATSEY METODOM SUMMARNYKH PREDSTAVLENIY]
G. N. Polozhiy Nov. 1966 13 p refs Transl. into ENGLISH from Prikl. Mekh., Akad. Nauk Ukr. SSR (USSR), v. 1, no. 12, 1965 p 1–8
(NASA-TT-F-10402) CSCL 20K

Discussion of the solution of the basic biharmonic problem for any singly or doubly connected region G having a piecewise-smooth boundary. It is shown that by conformal mapping of the region G onto a circle (or a ring), the solution of the problem at a large number of nodes of the G grid can be reduced to the solution of a system of linear algebraic equations with few unknowns (equal to the number of the contour or preconsoured nodes of the G grid). This can be achieved by the method of summary representations in which the grid is not firmly established from the start, but is constructed in accordance with a well-defined rule depending on the form of the function used to realize the conformal mapping of a circle onto a given region. Author

N67-25013*# National Aeronautics and Space Administration, Washington, D. C.
ON THE PROBLEM OF ELASTIC EQUILIBRIUM OF AN ELLIPSOID OF REVOLUTION [SUL PROBLEMA DELL'EQUILIBRIO ELASTICO DI UN ELLISSOIDE DI ROTAZIONE]
Orazio Tedone Mar. 1967 9 p Transl. into ENGLISH from Atti Accad. Naz. Lncei, Rend., Classe Sci. Fis., Mat. Nat. (Rome), ser. 5, v. 14, 1905 p 76–84
(NASA-TT-F-10786) CFSTI: HC $3.00/MF $0.65 CSCL 20K

The subject problem is analyzed for the case where the surface displacements are given using the theory of Green's functions. The case where the surface stresses are specified is briefly discussed. Author

N67-25016*# Holman (John F.) and Co., Inc., Washington, D. C.
DETERMINATION OF CRITICAL LOADS RESPONSIBLE FOR THE DEVELOPMENT OF INITIALLY WIDE CRACKS [OPREDELENIYE KRITICHESKIKH NAGRUZOK, VYZYVAYUSHCHIKH RAZVITIYE RASSHIRENNYKH TRESHCHIN]
A. A. Kaminskiy Washington, NASA, Apr. 1967 9 p refs Transl. into ENGLISH from Prikl. Mekhan. i Tekhn. Fiz. (USSR), v. 2, no. 1, 1966 p 83–87
(Contract NASw-1495)
(NASA-TT-F-10898) CFSTI: HC $3.00/MF $0.65 CSCL 20K

Discussion of a problem in the theory of brittle-fracture cracks, where an elastic body (infinite plane) is weakened by an initially wide crack. An analysis of the two-dimensional problem in the theory of elasticity for an infinite plane containing an incision of arbitrary shape, with one symmetry axis and one or two cuspidal points at the contour, is reduced to the solution of two systems of linear algebraic equations. It is shown that the width of the initial crack has only a slight effect on the value of the critical load required to initiate the development of a crack. This is seen to indicate that the representation of a crack as a cut of zero width is justified even for rather wide cracks. Author

N67-25017*# National Aeronautics and Space Administration, Washington, D. C.
ON THE ELASTIC EQUILIBRIUM OF A BODY LIMITED BY A CONE OF REVOLUTION [SULL'EQUILIBRIO ELASTICO DI UN CORPO LIMITATO DA UN CONO DI ROTAZIONE]
Orazio Tedone Mar. 1967 7 p refs Transl. into ENGLISH from Atti Accad. Naz. Lncei, Rend., Classe Sci. Fis., Mat. Nat. (Rome), ser. 5, v. 14, 1905 p 316–322
(NASA-TT-F-10790) CFSTI: HC $3.00/MF $0.65 CSCL 20K

The subject problem is analyzed for the case of a cone of revolution where the surface displacements are given using the theory of Green's functions. The case where the surface stresses are specified is briefly discussed. Author

N67-25030*# National Aeronautics and Space Administration, Washington, D. C.
STUDY OF THE AEROELASTIC INSTABILITY OF A FLAT RECTANGULAR PANEL [ETUDE DE L'INSTABILITE AEROELASTIQUE D'UN PANNEAU RECTANGULAIRE PLAN]
Roland Dat, Gerard Faure, and Suzanne Chopin Jan. 1967 13 p refs Transl. into ENGLISH from Rech. Aerospatiale (France), no. 112, May–Jun. 1966 p 27–32 Paper Presented at the Sci. Meeting of the O.N.E.R.A., Chatillon, France, 22–24 Jun. 1966
(NASA-TT-F-10645) CFSTI: HC $3.00/MF $0.65 CSCL 20K

Panel flutter investigations were carried out using low-aspect ratio rectangular panels with built-in leading and trailing edges and with free lateral edges. Numerous tests repeated in various wind-tunnels have shown that the boundary layer effect is rather small. Applying the three-dimensional flow theory improves appreciably the predictions of the critical conditions but still notable gaps were found between the theoretical stability limits and those given by wind-tunnel tests. Author

N67-25033* National Aeronautics and Space Administration, Washington, D. C.
ON THE STABILITY OF ELASTIC EQUILIBRIUM
Warner Tjardus Koiter (Ph.D. Thesis—Delft Polytechnic Inst.) Mar. 1967 209 p ref Transl. into ENGLISH of the book "Over de Stabiliteit van het Elastisch Evenwicht" Amsterdam, H. J. Paris, 1945
(NASA-TT-F-10833) CSCL 20K

Older theories of elastic stability and elastic equilibrium are modified and extended to include the differing behavior of different structures in the vicinity of the theoretical buckling load. The load acting on a structure is represented by the product of a unit load system and a load parameter λ, from which the equilibrium state, at continuous increase in λ from zero, is mathematically formulated. The difference in elastic behavior of different structures at loads close to the crippling load is attributed to the differing character of the possible neighboring equilibrium states which, in turn, depend on the equilibrium stability at the buckling load. Author

N67-25034* International Information, Inc., Philadelphia, Pa.
COMPARATIVE STUDY OF NUTATION DAMPERS [ETUDE SUR LA COMPARAISON D'AMORTISSEURS DE NUTATION]
Washington, NASA, Jan. 1967 115 p Transl. into ENGLISH from the French
(Contract NASw-1499)
(NASA-TT-F-10372) CSCL 22B

A comparative bibliographic, analytical, and technological study of nutation dampers is presented. The bibliography area considers the different types of nutation dampers, dampers with fluid rings, ball dampers, and the dynamics of solid bodies. In the analytic area studies are presented of discontinuous and mixed systems, and of meridian ball, pendular meridian, meridian rectilinear ball, parallel ball, and parallel pendular dampers. The technology of manufacturing ball type of dampers is examined along with problems posed by the simulation on models. C.T.C.

N67-25036*# Holman (John F.) and Co., Inc., Washington, D. C.
STRESS CONCENTRATION NEAR AN ELLIPTICAL HOLE IN A STEEP SPHERICAL SHELL [KONTSENTRATSIYA NAPRYAZHENIY VOZLE ELLIPTICHESKOGO OTVERSTIYA V NEPOLOGOY SFERICHESKOY OBOLOCHKE]
N. P. Fleyshman and V. A. Galazyuk Washington, NASA, Apr. 1967 10 p refs Transl. into ENGLISH of the book "Dinamika i Prochnost' Mashin" Kharkov, Izd. Kharkovskogo Univ., 1966 p 23–29
(Contract NASw-1495)
(NASA-TT-F-10894) CFSTI: HC $3.00/MF $0.65 CSCL 20K

A solution is given of the stress concentration problem for steep spherical shells with an arbitrary elliptical hole. Equations are derived that satisfy any boundary conditions over the elliptical hole perimeter. For the arbitrary constants of integration, a regular infinite set of algebraic equations is constructed and is solved by the method of successive approximation. Author

N67-25051*# State Univ. of Iowa, Iowa City.
AN INTEGRAL EQUATION METHOD IN PLANE ELASTICITY
Kwan Rim and Allen S. Henry Washington, NASA, May 1967 43 p refs
(Grant NsG-576)
(NASA-CR-779) CFSTI: HC $3.00/MF $0.65 CSCL 20K

A direct numerical method is developed for solving the first fundamental boundary value problem of plane elastostatics. The method is based on the formulation of the biharmonic stress function in terms of two harmonic functions and the subsequent

representation of the harmonic functions as potential functions, each containing an unknown source density function. The boundary conditions yield two coupled integral equations of the Fredholm type, the solution of which determines the source density functions. Numerical solutions for the unknown source densities are determined by approximating the Fredholm equations by sets of simultaneous algebraic equations which may be set up and solved by a high-speed digital computer. Once the source density functions are known, stresses may be calculated anywhere in the elastic domain. Numerical illustrations are presented for a circular region loaded with diametrally opposite concentrated forces and for an infinite domain with an elliptic internal boundary subjected to a constant pressure. Author

N67-25052*# Astro Research Corp., Santa Barbara, Calif.
THE FLUTTER OF TOWED RIGID DECELERATORS
Richard H. MacNeal. Washington, NASA, May 1967 39 p refs
(Contract NAS1-5605)
(NASA-CR-766) CFSTI: HC$3.00/MF$0.65 CSCL 01A

The flutter of a rigid drag body towed behind a massive primary body by means of a flexible cable is examined. Criterion is used to show that, to prevent flutter for all cable lengths, the real part of the mechanical input impedance to the drag body at the cable attachment point must be positive at all frequencies. This result is used to derive relationships between geometric and aerodynamic parameters that define the boundary for unconditional stability. General results show that stability is improved by moving the cable attachment point forward and that the optimum position of the center of gravity is midway between the cable attachment point and a modified center of pressure. Results of the general analysis are applied to a conical shell decelerator in Newtonian flow. It is shown that a conical shell towed from its apex and with uniform surface mass density is unconditionally stable provided that the semiapex angle exceeds 15.5°. Author

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N67-23512 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HEAT TRANSFER WITH TURBULENT FLOW OF MERCURY IN NARROW ANNULAR CHANNELS
V. I. Petrovichev. *In its* Certain Questions in Exptl. Phys. 26 Jul. 1966 p 121–130 refs (See N67-23501 12-23)

Experimental results are represented of the heat transfer of mercury in narrow annular channels for two ratios of external to internal diameters (1.42 and 1.77), for the case of external heating under conditions of constant thermal load on the external tube wall. Experimental data for length averaged heat transfer coefficients are treated on the basis of equivalent hydraulic diameter. The possibility of calculating heat transfer for the given case on the basis of usual formulas for heat transfer of liquid metals in smooth round pipes is demonstrated. Author

N67-23642# California Univ., Berkeley. Coll. of Engineering.
TRANSIENT BOILING PHENOMENA. VOLUME I Final Report
V. E. Schrock, H. A. Johnson, A. Gopalakrishnan, K. E. Lavezzo, and S. M. Cho. May 1966 217 p refs
(Contract AT(11-1)-34)
(NE-66-2; SAN-1013, Vol. 1) CFSTI: HC$3.00/MF$0.65

A summary is presented of research performed as part of Reactor Heat Transients Project. The program had as a broad objective the development of sufficient understanding of the various aspects of boiling in transiently heated systems to permit analysis of water reactor excursions. The research has included both experimental and theoretical approaches. In the experimental program, heat transfer and void were measured on a surface simulating a nuclear reactor fuel element. The power supplied electrically to the heating surface was increased exponentially with time to simulate a reactor excursion. All the experiments were performed with the transient initiated from an isothermal system state. Both pool (stationary liquid) and flow channel configurations were employed. A set of nominal values of the important parameters was chosen for the basic test program covering the range of pressure from ambient to 2000 psia, flow velocity from 0 to 14 fps, exponential period from 5 to 50 milliseconds, and initial liquid subcooling ranging from 0° to 112°F. A number of auxiliary experiments were performed to supplement the basic transient test program; these experiments were done to provide basic information pertinent to analytic studies and to fully characterize the equipment used in the basic test program. Analytical studies of the problem were conducted in three distinct areas: (a) transient non-boiling heat transfer to stationary and flowing liquid, (b) nucleation on a heated surface, and (c) void growth. These analyses are successful in adding insight and, with the experimental data, provided some basis for design calculations. The complexity of the problem is so great, however, that very detailed and accurate predictions are not yet possible for all aspects of the problem, particularly the void. Author (NSA)

N67-23624# Instituto Nacional de Tecnica Aeroespacial, Madrid (Spain).
DIFFUSION FLAMES AND SUPERSONIC COMBUSTION Final Report
I. Da-Riva, E. Fraga, A. Linan, and J. L. Urrutia. 1 Oct. 1966 44 p refs
(Grant AF-EOAR-65-69)
(AFOSR-67-0098; AD-645163) CFSTI: HC$3.00/MF$0.65

The paper describes some analytical work connected with the purely diffusive mode of supersonic combustion. The basic problems considered were: the study of the hydrogen-air diffusion flames, under both close to and far from equilibrium conditions, and the study of the aerodynamic field near the injector exit when the ratio of injected to outer total pressures is small. The internal structure of hydrogen-oxygen diffusion flames close to equilibrium has been studied using the first order approximation of an asymptotic expansion method, in which the large parameter represents the ratio between a characteristic mechanical time and a chemical time. Far from equilibrium conditions, the above mentioned solution fails. However, when a free jet of hydrogen, parallel to the air stream is used for injection purposes, a very simple near frozen approach may be used. The main simplifying features of such an approach being: the use of an overall chemical reaction, the assumption that fuel and oxidizer mix without appreciable depletion and chemical heat release, and the linearization of the mixing problem. Author (TAB)

N67-23637# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Aerospace Engineering and Applied Mechanics.
COMBUSTION INSTABILITY IN LIQUID PROPELLANT ROCKET ENGINES Final Report
Vito D. Agosta and Sanford S. Hammer. Oct. 1966 22 p refs
(Contract AF 49(638)-1263)
(PIBAL-1000; AD-645634) CFSTI: HC$3.00/MF$0.65

The investigation is concerned with the development of a theoretical model for combustion instability, in the longitudinal mode, occurring in liquid propellant rocket engines that are employed in current practice. Experimental results are used both to

help generate realistic physical models for combustion-wave phenomena in heterogeneously reacting systems, and for subsequent verification of theoretical results. Author (TAB)

N67-23650*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
APPLIED MECHANICS
In its Supporting Res. and Advanced Develop. 28 Feb. 1967 p 139–142 refs (See N67-23641 12-11)

Base heating by radiation from the wakes of ablating vehicles is discussed, as is a thermal analysis program containing subprograms to compute the infrared "script F" and the heat input due to solar heating. The base heating study was carried out to estimate effects on a hyperbolic Mars entry, with both the viscous and inviscid wakes treated. Numerical bounds were difficult to place on the results because the ablation was attributed largely to spallation, the effect of ambient gas composition was unknown, and radiation below a wavelength of 2 u was not studied. It is found, for example, that as the carbon-to-oxygen ratio in the ablative material decreases, the level of carbon monoxide in the boundary layer increases. The ultraviolet radiation from carbon monoxide (4+) may become an important factor. M.W.R.

N67-23655*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
RESEARCH AND ADVANCED CONCEPTS
In its Supporting Res. and Advanced Develop. 28 Feb. 1967 p 202–223 refs (See N67-23641 12-11)

Apparent optical properties of window-covered spherical cavities are reported along with an illustration of the Greenhouse effect. Results obtained with an annular hohlraum are given for the thermal radiation from ionized argon, and a nonrotating Rankine cycle liquid metal magnetohydrodynamic (MHD) system is under investigation. This liquid MHD power conversion system uses lithium that is accelerated by cesium vapor in a two-phase nozzle, separated from the cesium, decelerated in an MHD generator, and returned to the nozzle by a diffuser and heat source. Gaseous breakdown from an applied electric field for three component gases are studied as possible atmospheres of Mars and Venus. Paschen curves for the gas mixtures and for extra high purity dry nitrogen and spectroscopic grade argon are included. Despite the similarity between the curves for the proposed planetary atmospheres and the nitrogen, it is noted that a slight amount of impurity of an unknown minor constituent could have considerable effect on the breakdown potential. M.W.R.

N67-23679# ARO, Inc., Arnold Air Force Station, Tenn.
THERMODYNAMIC PROPERTIES OF AIR FROM 300 TO 6000°K AND FROM 1 TO 1000 AMAGATS
Martin Grabau and H. S. Brahinsky Arnold Eng. Develop. Center, Jan. 1967 60 p refs
(Contract AF 40(60)-1200)
(AEDC-TR-66-247; AD-646172) CFSTI: HC$3.00/MF$0.65

Tables for the thermodynamic properties of equilibrium air are presented at intervals of log rho = 0.2, the density rho in amagats extending from 1 to 1000 amagats and at temperature intervals of 100 deg from 300 to 6000K. In accordance with full discussion in the text of the report, the compressibility factor Z at 300 and 400K is extrapolated to 1000 amagats by linear extrapolation of log (Z - 1) against log rho at constant temperature. At 5000 and 6000K the values of Z were obtained from unpublished virial corrections furnished by Joseph Hilsenrath of the National Bureau of Standards. Interpolations between these extremes of temperature are based on an empirical equation for the pressure-temperature lines at constant density, the form of which fits known data at medium densities and also predicts data at temperatures below 300K. Author (TAB)

N67-23682# United Kingdom Atomic Energy Authority, Harwell (England). Information Branch.
THERMOANALYTICAL AND X-RAY INVESTIGATIONS IN THE LEAD–TELLURIUM SYSTEM
W. Lugscheider, H. Ebel, and G. Langer 1966 6 p refs Transl. into ENGLISH from Z. Metallk. (Stuttgart), v. 56, 1965 p 851–852
(AERE-TRANS-1063) CFSTI: HC$3.00/MF$0.65

On the basis of results of thermoanalytical and X-ray measurements the Pb–Te phase diagram was amplified and corrected in a few points, and the lattice constant of the compound PbTe and its linear thermal coefficient of expansion were determined. Author (NSA)

N67-23734# Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorbauelemente.
THERMODYNAMICS OF DROPS IN VAPOR-COOLED CIRCUITS [THERMODYNAMICK VON TROFFEN IN DAMPF-KUEHLKREISEN]
Heinz Sundermann Sep. 1966 5 p
(KFK-410) CFSTI: HC$3.00/MF$0.65

Equilibrium equations correlating the salt concentrations in drops after evaporation under the influence of surface stress, the complete evaporation of the drops, and their stationary radius are presented. NSA

N67-23765# Aeronutronic, Newport Beach, Calif.
POTASSIUM CONDENSATE DROPLET SIZE DETERMINATION
Hans D. Linhardt 1 Aug. 1966 46 p refs
(Contract AT(04-3)-595)
(TID-23287) CFSTI: HC$3.00/MF$0.65

The results of experimental determinations of potassium vapor condensate droplet sizes for typical thermodynamic expansion processes in the $1500°F < T < 1000°F$ temperature range and theoretical exhaust quality conditions $0.80 < X < 0.95$ are summarized. For this purpose, a forced convection, boiling-condensing, closed loop potassium facility was developed. The potassium loop provided the specified potassium vapor conditions to the test section which consisted of various expansion nozzles and nickel plated wedge specimens placed downstream of the nozzle. After performance of seven (four to five hours) short duration tests, the wedge erosion damage lengths were measured and correlated with two phase flow theory. The analysis of the test data provided internally consistent, accurate, and reproducible information on free stream droplet size as a function of theoretical vapor nozzle exhaust quality and saturation inlet temperature. The significant result is that the measured average free stream droplet size is of the order of 0.50 μ, which is an order of magnitude larger than the average droplet size predicted by present condensation theories. In addition, the exploratory program has proven that the selected nozzle-wedge erosion method works and, therefore, should be utilized for future more detailed two phase flow investigations. Author (NSA)

N67-23773# New Mexico Univ., Albuquerque. Bureau of Engineering Research.
METHODS FOR ANALYZING SPECTRAL AND DIRECTIONAL EFFECTS IN RADIATIVE HEAT TRANSFER AND EXPERIMENTAL MEASUREMENTS OF HEAT
C. H. Treat and M. W. Wildin Oct. 1966 72 p refs Prepared for Sandia Corp.
(Contract AT(29-1)-789)
(SC-CR-66-2124) CFSTI: HC$3.00/MF$0.65

Techniques for treating radiant heat transfer between bodies whose thermo-optical properties are functions of frequency and direction are discussed. Since techniques for treating frequency-dependent properties are fairly well established, approximate methods which have been advanced for dealing with

direction-dependent properties are described. It is shown that the more accurate approximations require much data for the thermo-optical properties and the simultaneous solution of large numbers of linear algebraic equations. The modeling technique which is used to obtain experimental results for comparison with the analytical results published for one configuration of radiating extended surfaces and the design and assembly of a model are described. Some of the experimental and analytical results are presented and discussed. Author (NSA)

N67-23878# Technische Hochschule, Munchen (West Germany).
INVESTIGATION OF THE BOILING OF LIQUIDS IN VERTICAL TUBES Final Report
Ernst Schmidt Oct. 1966 48 p ref
(Contract N62558-3701)
(AD-644359) CFSTI: HC $3.00/MF $0.65

The project investigated experimentally the boiling of water in vertical tubes up to pressures of 1450 lbs/sq. in. Basically the apparatus for evaporating the water consisted of a stainless steel tube, two meters in length having an inside diameter of 16mm, and an outside diameter of 20mm. This was heated by a transformer attached to the tube and energized by 50 cycle alternating current. Experiments were made with heat fluxes up to 7.8 Watts/sq. cm at temperatures from 114 to 165C. Author (TAB)

N67-24027# Philips Gloeilampenfabrieken N. V., Eindhoven (Netherlands).
A STUDY OF A NEW MAGNETIC REFRIGERATING CYCLE
J. R. van Geuns 1966 110 p refs *Its* Res. Rept. Suppl. No. 6
CFSTI: HC $3.00/MF $0.65

The possibility of using magneto-caloric effects for a refrigerating machine in which cold can be generated at a temperature of about 4°K has been investigated. The cycle evolved for application at higher temperature resembles in many respects the Stirling cycle used in gas-refrigerating machines and hot-gas engines. In the new cycle, helium is used to transfer heat from the paramagnetic material to a heat exchanger and vice versa. The helium is also used as a regenerator. In order to prevent phase transitions, the helium pressure chosen is above the critical pressure. A theoretical analysis of the refrigerator based on the new cycle is given. After a detailed exposition of the principle underlying this cycle, a simplified model for the fairly complicated processes taking place in the new refrigerator is introduced. Attention is devoted to the regenerator, whose behavior deviates from that of normal regenerators, in that work can be carried out on the paramagnetic material during its passage through the regenerator. The design of a magnetic refrigerator working between 15° and 4°K is given. The measurements carried out in order to obtain paramagnetic materials suitable for the new refrigerator are discussed, including a number of mixed oxides of rare-earth and other metals. The magnetic susceptibility and the entropy of these materials were also measured. Author

N67-24037 Aeronautical Research Council (Gt. Brit.)
THERMAL CONDUCTANCE TESTS ON CABIN WALL INSULATION ASSEMBLIES FOR A SUPERSONIC TRANSPORT AIRCRAFT
Ian I. Mc Naughtan and P. A. Keane London, HMSO, 1967
81 p refs Supersedes RAE-TN-MECH-ENG-405; ARC-27497
(ARC-CP-910; RAE-TN-MECH-ENG-405; ARC-27497) HMSO: 16s

Thermal conductance tests have been made on a number of insulation assemblies for the cabin wall of a supersonic transport aircraft at outer skin temperatures in the range 90° to 120°C. In all cases the test specimens were assembled onto structures representing the fuselage wall. In addition tests were made on a representative fuselage to floor beam joint. The results of the tests are presented and discussed, and the problems of insulating hot cabin walls are outlined. Author

N67-24155# Brookhaven National Lab., Upton, N. Y.
HIGH-TEMPERATURE LIQUID-METAL TECHNOLOGY REVIEW, VOLUME 4, NO. 5. A BIMONTHLY TECHNICAL PROGRESS REVIEW
Oct. 1966 50 p refs
(Contract AT(30-2)-GEN-16)
(BNL-50030(PR-23), Vol. 4, No. 5) CFSTI: HC $3.00/MF $0.65

A total of 22 reviews is presented of reports and papers dealing with developments in high-temperature liquid-metal technology. Among the topics covered are heat transfer, fire hazards, mass transfer, cavitation, and carbon metering. Graphs of data are included. NSA

N67-24156# Brookhaven National Lab., Upton, N. Y.
HIGH-TEMPERATURE LIQUID-METAL TECHNOLOGY REVIEW, VOL. 4, NO. 4. A BIMONTHLY TECHNICAL PROGRESS REVIEW
Aug. 1966 62 p refs
(Contract AT(30-2)-GEN-16)
(BNL-50021(PR-22), Vol. 4, No. 4) CFSTI: HC $3.00/MF $0.65

Reviews are presented of current topical and progress reports in the field of high-temperature liquid-metal technology. The reviews cover the following subjects: materials development, corrosion and mass transfer, heat transfer, fluid dynamics, instrumentation, purification, component development, physical properties, thermodynamics, chemical analysis, and power systems. The reports reviewed are from programs for the development of power systems for space vehicles and of fast breeder reactors. NSA

N67-24267 Israel Inst. of Tech., Haifa. Dept. of Aeronautical Engineering.
EFFECT OF SWIRL ON FLAME STABILIZATION
A. Chervinsky and Y. M. Timnat Jan. 1967 21 p refs
(TAE-61) CFSTI: HC $3.00

The effect of swirl on the stabilization and length of turbulent Butane–Propane air flames was studied. Using a simplified form of the equations of motion it was shown that the introduction of swirl into the air–fuel stream emerging from the burner exit causes a significant decrease of the velocity gradients near the wall of the burner. It was also found that the distance from the burner exit at which the flame stabilizes and the flame length decrease with increasing degree of swirl. Semi-empirical expressions describing the dependence of the stabilization distance and flame length on the degree of swirl were given and compared with the experimentally observed values. Author

N67-24273*# Thiokol Chemical Corp., Bristol, Pa.
ANALYSIS AND CORRELATION OF THERMODYNAMIC CYCLES FOR SPACE APPLICATIONS
David M. Adams *In* NASA. Marshall Space Flight Center Proc. of the Interdisciplinary Symp. on Apollo Appl. Programs, 12–13 Jan. 1966 Dec. 1966 p 117–142 refs (See N67-24268 12-30)

Quantitative prediction and correlation of performance factors, thermal efficiencies, and optimum cycle design requirements for any thermodynamic cycle or any individual process in the cycle was possible by the introduction of the concept of maximum cycle irreversibility and the utilization of the principles of the Second Law of Thermodynamics. Optimization of the thermal efficiency to cycle specific weight ratio was analyzed and example problems were included to illustrate the practical applications of the concepts presented. The study concentrated on the analysis and design requirements of thermodynamic cycles intended for usage as power systems in space where power output to specific weight ratio must be optimized. Author

N67-24370# Bureau of Mines, Bartlesville, Okla. Petroleum Research Center.

THERMODYNAMIC PROPERTIES OF COMPRESSED GASES
Final Technical Summary Report

R. H. Harrison, R. T. Moore, and D. R. Douslin 14 Dec. 1966 61 p
(Contract AF-AFOSR-65-10)
(AFOSR-67-0640; AD-647893) CFSTI: HC$3.00/MF$0.65

The purpose of the project is to provide reliable values for the thermodynamic properties of key compressed gaseous systems which can be used as points of reference for a better understanding of the laws of mixing. For several reasons the binary system, methane-tetrafluoromethane, fulfills the requirements of a key system for which a detailed study is justified. The molecules of both methane and tetrafluoromethane are quasi-spherical, possess similar skeletal structures, correspond to a simple interaction model, and can be expected, therefore, to respond reasonably well to a theoretical interpretation of the results. Accurate P-V-T data are available for this system over wide temperature and pressure ranges. Also, both substances are stable of high temperatures thus making possible extended experimental studies. Tables of thermodynamic properties are reported for the complete methane-tetrafluoromethane compressed gaseous system consisting of pure methane, pure tetrafluoromethane, and 25, 50, and 75 mole percent methane + tetrafluoromethane mixtures. Author (TAB)

N67-24460*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

LOCAL HEAT-TRANSFER COEFFICIENTS AND STATIC PRESSURES FOR CONDENSATION OF HIGH-VELOCITY STEAM WITHIN A TUBE

Jack H. Goodykoontz and Robert G. Dorsch Washington, NASA, May 1967 68 p refs
(NASA-TN-D-3953) CFSTI: HC$3.00/MF$0.65 CSCL 20M

Local heat-transfer and static-pressure data were obtained for steam condensing in vertical downflow inside a 0.293-inch-inside-diameter by 8-foot-long copper tube. Inlet vapor velocities ranged from approximately 300 to 1000 feet per second with complete condensing occurring in the test section. The condenser was cooled with water flowing countercurrently in an annulus around the condenser tube. The mean condensing heat-transfer coefficient varied from 3860 to 11,850 Btu per hour per square foot per °F over a test-fluid total mass velocity range from 64,900 to 336,000 pounds per hour per square foot. Static-pressure changes in the two-phase region varied from a net increase of 1.32 pounds per square inch to a net decrease of 35.34 pounds per square inch. Axial static-pressure profiles were a function of the vapor flow rate and heat flux. Overall friction-pressure losses for the two-phase region were computed from measured static-pressure changes and correlated in terms of common pipe-friction parameters that included flow rate, total condensing length, and specific volume of the vapor at the condenser inlet. Author

N67-24478*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

ASSESSMENT OF CONVECTION, CONDUCTION, AND EVAPORATION IN NUCLEATE BOILING

Robert W. Graham and Robert C. Hendricks Washington, NASA, May 1967 45 p refs
(NASA-TN-D-3943) CFSTI: HC$3.00/MF$0.65 CSCL 20M

Various heat-transfer mechanisms including convection, transient conduction, and evaporation are discussed and evaluated as to their contribution to the overall nucleate-boiling heat flux. Recent boiling experiments that pertain to these mechanisms are cited. From the evaluation, a nucleate-boiling model is proposed that includes elements of each of the aforementioned mechanisms. From a comparison of the model with experimental information on water and methanol, no single mechanism dominates over the entire boiling heat-flux range. It is true, however, that evaporation becomes the chief contributor for heat fluxes that are greater than 20 percent of the critical value. Transient conduction is an important contributor to the total heat flux over a broad range of conditions. The cyclic removal of heat from the surface into the liquid sublayer by conduction appears to be an efficient process compared with steady-state free convection. The repeated destruction of the thermal layer that ensues the departure of a bubble enables this transient conduction process to be repeated at a bubble site. The overall model presented herein emphasizes that nucleate boiling should be thought of primarily as a series of transient heat-transfer processes going on over distinct regions of the surface. Author

N67-24499# Ballistic Research Labs., Aberdeen Proving Ground, Md. Exterior Ballistics Lab.

PRECURSOR INFRARED RADIATION FROM HYPERVELOCITY ABLATING VEHICLES

William H. Mermagen Sep. 1966 102 p refs
(BRL-R-1338; AD-647694) CFSTI: HC$3.00/MF$0.65

Infrared radiation was observed from the cold, unshocked air as far as thirty body diameters ahead of ablating, hypervelocity vehicles. This precursor radiation is attributed to various constituents of air such as CO2 and H2O, as well as C2 and CN contamination. Resonance radiation due to photon flux absorption from the excited air and ablation products around the vehicles is considered as the dominant mechanism for the production of an infrared precursor. Both wideband and spectrally filtered measurements of the precursor radiation were made. Ablating and non-ablating cylinders and spheres were fired at velocities up to 18,000 feet per sec at ambient pressures of from 20 to 75 Torr. Indium antimonide infrared detectors and photomultiplier tubes were used to observe the precursor radiation. Some approximate theoretical formulas were derived to account for precursor intensities. The firing data are compared with theoretical estimates and fair agreement is observed. The most important contributor to the precursor signal was seen to be water vapor. The effect of ambient carbon dioxide on both precursor and peak radiation was small. The presence of C2 and CN as contaminants in the apparatus was suggested as a result of measurements in the infrared for the C2 Phillips and Ballik-Ramsay systems and the CN red system. Author (TAB)

N67-24570# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.

FIRE TEST AND THERMAL BEHAVIOR OF 15-TON LEAD-SHIELDED CASK

G. P. Wachtell and J. W. Langhaar Oct. 1966 60 p refs
(Contract AT(07-2)-1)
(DP-1070) CFSTI: HC$3.00/MF$0.65

A 15-ton lead-shielded cask was subjected to a large, open-air petroleum fire. Experimental results were correlated by means of electric analog computation, using various assumed values for important parameters. The radiant absorptivity (α) of the cask was found both by this method and by hand calculations to be about 0.6 based on an effective fire temperature of 1800°F and an emissivity of unity, unity being appropriate in this case because of the method of measuring fire temperature. Although the cask was externally finned for convective cooling under normal operating conditions, α is calculated from the area of the outer shell excluding the fins. Convection of molten lead in the walls was found to be such that the horizontal temperature gradient in the molten lead was negligible. On the other hand, the vertical temperature gradient was about 8°F per inch of height, with some indication of a higher gradient in upward-facing walls than in sideward-facing walls. Fire tests of chrome-plated and unplated objects to determine extent of sooting effect on α were inconclusive because of destruction of the chrome plating. Test of a finned box half the size of the cask yielded a value of α essentially equal to that of the cask, indicating no size effect, and constant for the duration

of the test, indicating no effect of sooting on α. Hand-calculation methods are presented for predicting the extent of melting as a function of time for lead-shielded casks of rectangular or cylindrical shape, for any selected fire conditions. Methods are also suggested for estimating the maximum cavity temperature in casks with either lead or nonmelting shielding. Author (NSA)

N67-24616*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

LOCAL HEAT-TRANSFER AND PRESSURE DISTRIBUTIONS FOR FREON-113 CONDENSING IN DOWNWARD FLOW IN A VERTICAL TUBE

Jack H. Goodykoontz and William F. Brown Washington, NASA, May 1967 40 p refs

(NASA-TN-D-3952) CFSTI: HC$3.00/MF$0.65 CSCL 20M

Local heat-transfer data and static-pressure distributions for Freon-113 condensing inside a vertical tube are presented. The test condenser was a 0.293-inch-inside-diameter by 8-foot-long, water-cooled copper tube. Incomplete condensing occurred in the condenser with exit qualities ranging from 0.05 to 0.40. Local condensing heat-transfer coefficients varied from 3300 Btu per hour per square foot per °F at the vapor inlet end to 200 Btu per hour per square foot per °F at the discharge end. The local condensing heat-transfer coefficients for Freon-113 were satisfactorily correlated by using a Carpenter-Colburn type of relation for high-velocity condensing. Overall friction–pressure losses were computed and found to be a function of a group of variables used in single-phase pipe-friction problems. Author

N67-24642*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

INTRODUCTION TO RESEARCH ACHIEVEMENTS REVIEW ON THERMOPHYSICS RESEARCH AT MSFC

Gerhard B. Heller *In its* Res. Achievements Rev., Vol. II 1966 p 1–3 refs (See N67-24641 12-14)

Results of work on the modes of heat transfer of underdense dielectric materials are presented. Plots are given showing the effect of change in the bulk density on the thermal conductivity of powder particles. In the area of thermal control, an experimental model of a space radiator was built, and is schematically depicted. Studies are being conducted on improving the low thermal diffusivity of the liquid layer, and on reducing the expansion and contraction of fusible material between the liquid and solid state. A packaging technique was developed that increases the thermal diffusivity while maintaining the fusible material in thermal contact with the heat source during all phases of operation. L.S.

N67-24643*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

EXPERIMENTAL RESULTS IN THERMAL SIMILITUDE

Billy P. Jones *In its* Res. Achievements Rev., Vol. II 1966 p 5–10 refs (See N67-24641 12-14)

Two means of deriving criteria for obtaining thermal similarity (the basis for thermal modeling), differential equation and pi-theorem techniques, are noted. Experimental confirmation was obtained for the derived thermal modeling criteria for the transient case for several situations that represent simplified versions in the thermal aspects of flight hardware. Geometric distortion in minor dimensions was found to be a useful technique in satisfying criteria. Results indicate that thermal similitude can be useful in solving thermal problems during the design stage. L.S.

N67-24644*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

EMISSIVITY PHYSICS

Edgar R. Miller *In its* Res. Achievements Rev., Vol. II 1966 p 11–17 refs (See N67-24641 12-14)

Space environment effects on the emissivity and optical absorption of thermal control surfaces and the associated problems of laboratory simulation and measurements, are discussed. Data are presented for the effects of solar wind, electromagnetic irradiation, and micrometeoroids on thermal control surfaces (such as metallic coatings). In situ measurements and recovery of thermal control coupons from an experiment on the Pegasus III flight are being conducted to provide answers on the long term stability of important coating systems in low earth orbit space environments. L.S.

N67-24645*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

ULTRAVIOLET INTERACTIONS WITH SOLID MATERIALS

Gary M. Arnett *In its* Res. Achievements Rev., Vol. II 1966 p 19–26 refs (See N67-24641 12-14)

Studies elucidating some of the major problems connected with spacecraft coating instability when exposed to solar ultraviolet irradiation are presented. The studies are concentrated on ZnO-type pigmented thermal control coatings which are among the most stable white coatings available at the present time. Basic experimental and theretical research efforts in this area, both inhouse and on contract, are presented along with preliminary conclusions of various aspects of the program. Author

N67-24646*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

PEGASUS THERMAL EXPERIMENTAL RESULTS

William C. Snoddy *In its* Res. Achievements Rev., Vol. II 1966 p 27–31 (See N67-24641 12-14)

Results thus far obtained from the analysis of Pegasus orbital thermal data indicate that the temperature of the on-board electronics for all three Pegasus spacecraft is being maintained within the desired range in spite of an overheating of the S-IV stage and the service module adaptor. The successful operation of the thermal louvers attached to the electronics canister is credited with maintaining the proper thermal environment even though these difficulties were encountered. Results from an environmental effect sensor package indicate a space-environment-induced degradation of several thermal control coatings. Some of these supposedly space-stable coatings have had a 100% increase in their solar absorptance to infrared emittance ratio. Results from these sensors are also used to study the earth's albedo. The albedo has been found to vary greatly and results are now being correlated to weather photographs. Author

N67-24647*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

RESEARCH IN INSTRUMENTATION FOR RADIOMETRY AND SPECTROMETRY

Harlan D. Burke *In its* Res. Achievements Rev., Vol. II 1966 p33–40 (See N67-24641 12-14)

Infrared measuring systems typical of those flown on the Saturn vehicles are discussed. These systems are used to detect fires in the vehicle and to determine spectral characteristics of the exhaust plume, heat flux to the heat shield from the hot gases in the exhaust, and heat flux to other vehicle structures from aerodynamic forces during ascent. The principle of operation and typical parameters of each type of instrument are discussed. Author

N67-24709# Pennsylvania State Univ., University Park. Combustion Lab.

COMBUSTION BEHAVIOR OF THERMOPLASTIC POLYMER SPHERES BURNING IN QUIESCENT ATMOSPHERES OF AIR

R. H. Essenhigh Dec. 1966 30 p refs

(Contract Nonr-656(29))

(FS66-1(u); AD-646981) CFSTI: HC$3.00/MF$0.65

Thermoplastic polymer spheres of 1 or 2 m.m. initial diameter, burning in air while attached to silica fibres, have been found to burn like oil drops with a surrounding diffusion flame. Eleven different materials of c/h ratios from 0.5 to 1.2 were studied photographically to determine the variation of diameter with time. In general the materials followed the classic nusselt 'square-law' relation thus generating a burning constant, K. experimental values of K for the eleven materials ranged from 10 to 80 C.G.S. units. Being half to one quarter of the oil drop values this showed that their burning rates were 2 to 4 times faster because of the much closer approach of the surrounding flame to the drop surface. The overall 'oil-drop-equivalent' behavior, however, is misleading as an explanation of mechanism since the material has to pyrolyze before vaporizing; so the rate limiting process is not heat supply for evaporation, but heat supply for surface pyrolysis (since volumetric pyrolysis does not lead to a square law). To account for this, a sequence of pyrolysis steps of increasing activation energy is therefore postulated with only the last one, occurring at the slightly higher surface temperature, leading to vaporization effectively at the surface. Author (TAB)

N67-24742# Cornell Univ., Ithaca, N. Y. Sibley School of Mechanical Engineering.
AN INVESTIGATION OF THE HEAT TRANSFER ASPECTS OF HORIZONTAL TWO-PHASE FLOW Final Report
Howard N. McManus, Jr. Nov. 1966 8 p
(AD-646398) CFSTI: HC $3.00/MF $0.65

The research has as its purpose the study of the heat transfer aspects of two-phase flow and the associated fluid dynamics. A major portion of the effort was directed toward the understanding of the fluid dynamics and heat transfer in constant area horizontal annular two-phase flow. The heat transfer and fluid dynamics aspects of dispersed flows in contracting sections were also under examination. Author (TAB)

N67-24776# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ROLE OF DISPERSION IN THE PROCESSES OF RADIANT EXCHANGE OF ENERGY
V. N. Adrianov 7 Nov. 1966 15 p refs Transl. into ENGLISH from Teploenerg. (Moscow), v. 8, no. 2, 1961 p 63-66
(FTD-HT-66-303; TT-67-60876; AD-646710) CFSTI: HC $3.00/MF $0.65

The various problems in the theory of radiant exchange of energy lead to integral and integro-differential equations which have a very complicated mathematical structure. A strict and precise solution of these problems is not possible for the time being. Therefore all theoretical investigations of the different problems in radiant exchange of energy undertaken up to the present time in weakening media start from a number of simplified assumptions. Among such premises there is the assumption about the absence of dispersion in a medium (a purely absorbane one). Due to this as applicable to heat-technology problems, the character of the influence of dispersion in the process of radiant exchange has remained unsolved in both qualitative and quantitative relationships. In fact each real medium to some extent posesses the property of dispersion, as a result of which the clarification of the role of dispersion or radiation in the radiant exchange of energy affords theoretical and practical interest. In connection with this, in this article an attempt is made also to fill the gap noted and to analyze the role of dispersion as applicable to the transfer of radiant energy in a plane-parallel stratum of a weakening medium. Author (TAB)

N67-24782# Illinois Univ., Urbana. Coordinated Science Lab.
KINETIC THEORY OF THERMAL TRANSPIRATION
Yau Wu Feb. 1967 30 p refs
(Contracts DA-28-043-AMC-00073(E); N00014-66-00010-A01) (R-340; AD-647843) CFSTI: HC $3.00/MF $0.65

The thermal transpiration law has been revised in a rigorous treatment. This phenomenon, discovered by Newmann, Feddersen and Reynolds, has been treated by Maxwell and Knudsen from kinetic theory considerations. In the present report, it was shown that the Maxwell and Knudsen theories do not give a detailed, microscopic description and are only valid for a system with near Maxwellian distribution everywhere. However, the revised and exact theory contains a set of new invariants which deviate from the classical theory by a geometrical factor I. This factor (isotropy) is a measure of the isotropic characteristics of the velocity distribution function in a stationary non-equilibrium system. The new invariants of thermal transpiration in the Knudsen regime are p1/square root of T and n(square root of T) I. In general, I is not equal to unity or a constant value in a thermal transpiration system. Author (TAB)

N67-24783# General Electric Co., Schenectady, N. Y. Research and Development Center.
A STUDY OF SHOCK WAVE INDUCED REACTIONS Final Technical Documentary Report
Donald R. White Wright-Patterson AFB, Ohio, ARL, Sep. 1966 46 p refs
(Contract AF 33(657)-7945)
(Rept.-66-GC-0336; ARL-66-0177; AD-646559) CFSTI: HC $3.00/MF $0.65

A technique for generation of a laminar reaction zone in a detonable mix was found. Density measurements in these and in incident shock experiments confirmed existence of the von Neumann spike and demonstrated that the density there corresponds to full vibrational relaxation without chemical reaction for the combustion of D2, H2, C2H2, C2H4, CH4, and CO. A systematic study of vibrational relaxation of diatoms has resulted in an empirical correlation of relaxation time as a function of oscillator strength, reduced mass, and temperature that has superior predictive abilities. It was demonstrated that induction time is an insensitive function of the relaxation time of the reactants. The activation energy for shock-induced exothermic reaction in D2, H2, C2H2, and C2H4 is measured to be about 17.3 kcal/mole, and the induction times are in the ratio of 1.5, 1, 0.5, and 0.4, respectively, for a very lean stoichiometry. In reflected shock ignition studies, an activation energy of 17.3 kcal/mole is approached for low-pressure experiments and at higher pressure the density-normalized induction time increases markedly with pressure, yielding a much higher apparent activation energy. This is presumably due to the increasing importance at higher pressures of the termolecular recombination reaction forming HO2. The observed result is that the actual induction time rather than being inversely proportional to pressure, as it is above 1100K, varies directly with pressure and can be much less at 1 atm than at 5 atm. Author (TAB)

N67-24811# Brown Univ., Providence, R. I. Div. of Engineering.
RADIATIVE TRANSFER IN A GAS OF UNIFORM PROPERTIES IN LOCAL THERMODYNAMIC EQUILIBRIUM. PART 2. RELATIVE LINE INTENSITIES AND THE TREATMENT OF WEAK LINES Technical Report
Brian L. Hunt and Merwin Sibulkin Dec. 1966 65 p refs
(Contract Nonr-562(35))
(Nonr-562(35)/17; AD-648399) CFSTI: HC $3.00/MF $0.65

The report is concerned with the transfer of radiative energy by the lines of a gas of uniform properties in local thermodynamic equilibrium. By means of comparatively simple calculations, the relative intensities of the potentially strong lines of a simple (hydrogenic) spectrum are computed and these results are interpreted in detail. An important conclusion from these calculations is that the influences of lower state occupation number and line oscillator strength can, under some conditions, be outweighed by factors such as the line width and the local value of the Planck function. The remainder of the report is concerned with the numerous

weak lines associated with high quantum numbers. It is shown that these lines can be allowed for by extending the cross sections of the appropriate continuum processes. These techniques are then used to compare the intensities of groups of weak lines with the intensities of certain strong lines. Author (TAB)

N67-24812# Brown Univ., Providence, R. I. Div. of Engineering.
RADIATIVE TRANSFER IN A GAS OF UNIFORM PROPERTIES IN LOCAL THERMODYNAMIC EQUILIBRIUM. PART I: ABSORPTION COEFFICIENTS IN NONHYDROGENIC GASES
Brian L. Hunt and Merwin Sibulkin Dec. 1966 118 p refs
Sponsored by ARPA
(Contract Nonr-562(35))
(Nonr-562(35)/16; AD-648398) CFSTI: HC $3.00/MF $0.65

The report discusses the data needed to perform radiative transfer calculations in nonhydrogenic gases in local thermodynamic equilibrium and presents some approximate methods for computing the radiative energy transferred by spectral lines where the properties of the gas are uniform. The methods currently available for calculating the cross sections of radiative processes are described and compared. An accurate method for calculating the species composition of nitrogen is described and the results of such a calculation are presented. The important line broadening mechanisms are discussed and the potentially accurate, modern theories of line broadening are outlined. The results of these theories are used to justify approximate line profiles which are simple enough for use in radiative transfer calculations. Simple approximations to the exact curves of growth of intensity are described for lines with Doppler profiles and for lines with profiles of a class which includes the dispersion and quasi-static forms. The concept of the effective width of a line intensity profile is introduced and techniques are developed for dealing with the overlapping of the intensity profiles of small groups of closely spaced lines (as, for example, in a multiplet). Author (TAB)

N67-24814# Brown Univ., Providence, R. I. Div. of Engineering.
RADIATIVE TRANSFER IN A GAS OF UNIFORM PROPERTIES IN LOCAL THERMODYNAMIC EQUILIBRIUM. PART 3: A DETAILED CALCULATION FOR NITROGEN
Brian L. Hunt and Merwin Sibulkin Dec. 1966 130 p refs
(Contract Nonr-562(35))
(Nonr-562(35)/18; TR-18; AD-648400) CFSTI: HC $3.00/MF $0.65

The spectral lines are classified into various groups and the contribution of each group to the overall radiation from the gas is distinguished. The reduction in line intensity due to the background continuum is allowed for. The intensity due to a combination of up to 18 types of continuum and pseudo-continuum processes is computed with exact allowance for self-absorption. The results for the total intensity and the relative contributions of selected groups of contributors are presented graphically. In addition, an equivalent gray gas absorption coefficient is defined and the values presented. The results of the calculation demonstrate that, in most cases, the atomic and ionic lines are the most important contributors. When the gas is highly ionized, the dominant contributors are a few strong lines arising from same-shell transitions which have low-lying initial energy levels and are situated in the near ultra violet. A further interesting and unexpected result is that the intensities of the strongest lines are often significantly influenced by Doppler broadening of the line profiles. Author (TAB)

N67-24862# California Univ., Berkeley.
STUDY OF THE DEVELOPMENT AND STABILIZATION OF DETONATIONS Final Report, Oct. 1965–Oct. 1966
A. K. Oppenheim Oct. 1966 18 p refs
(Grant AF AFOSR-129-66)
(AFOSR-67-0419; AD-647447) CFSTI: HC $3.00/MF $0.65

The study concerns gas-wave-dynamic phenomena during the transient state from combustion initiation to stable detonation. The results should provide basic information on the generation of pressure waves by explosive reactions, important to understanding of combustion instability in rocket chambers and similar devices, as, for instance, supersonic combustion propulsion systems for hypersonic flight vehicles. Author (TAB)

N67-24979# Cambridge Univ. (England). Cavendish Lab.
GROWTH OF BURNING TO DETONATION IN LIQUIDS AND SOLIDS Annual Summary Report, 1965–1966
F. P. Bowden, T. Boddington, and J. E. Field Dec. 1966 14 p refs
(Grant AF-EOAR-66-03)
(Rept.-9; AFOSR-67-0520; AD-647392) CFSTI: HC $3.00/MF $0.65

A high-speed photographic study was made of the initiation of explosive liquids (using sparks and impact) and of single crystals of explosive solids (using shock and hot wires). The physical homogeneity of the material was shown to have a marked effect on its sensitivity. Studies of the fracture of inert solids showed the importance of specimen geometry, and of crack speed on the fragmentation process. Both high-speed photography and ultrasonic methods were used for the fracture work. One of the main advances was in the theoretical work on thermal explosion theory. Author (TAB)

N67-25041*# Michigan Univ., Ann Arbor. Dept. of Aerospace Engineering.
TWO PHASE DETONATIONS AND DROP SHATTERING STUDIES Annual Progress Report, 1 Feb. 1966–31 Jan. 1967
E. K. Dabora, K. W. Ragland, and A. A. Ranger Apr. 1967 128 p refs
(Contract NASr-54(07))
(NASA-CR-72225; UM-06324-3-T; APR-3) CFSTI: HC $3.00/MF $0.65 CSCL 21B

Experimental results on detonations in two phase mixtures of liquid diethylcyclohexane and gaseous oxygen are presented. Measurements of detonation velocity, and pressure and heat transfer behind the wave are made on 940 μ sprays at equivalence ratios .18–.96 and single streams of 2600 μ drops at an equivalence ratio of .23. In general, the velocities are lower than the theoretical Chapman–Jouguet velocities. The structure of the reaction zone of the detonation of the 2600 μ drops was studied by means of a piezoelectric transducer, thin film heat transfer gauges, and streak photography. Difference equations for detonations with mass, momentum and heat transfer at the boundaries, and expressions for transfer coefficients of mass, momentum, and heat transfer for diffusion limited laminar boundary layer behind a shock with vaporization and combustion are derived. Experimental data on the acceleration, deformation, and breakup time of water drops (750–2700 μ) by shock waves (M = 1.3–3.5) in air initially at NTP are also included. Differences between the dynamics of inert drops and reacting drops behind the detonation front are discussed. Author

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N67-24427# Arbeitsgruppe Biophysikalische Raumforschung, Frankfurt am Main (West Germany).

THE PART PLAYED BY USA UNIVERSITIES IN THE WORLD SPACE RESEARCH PROGRAM AND TRAINING YOUNG RECRUITS [DER ANTEIL DER USA-UNIVERSITAETEN AN DER WELTRAUMFORSCHUNG UND DIE NACHWUCHS-SCHULUNG]

Robert G. A. Lotz *In its* Extraterrest. Biophys. and Biol. [1966] p 21-29 (See N67-24424 12-27)

An outline of US university particpation in the NASA scientific space program is given. Most economic support centers on the education of future scientific personnel in the form of study grants, the enlargement of existing research facilities, and the creation of educational centers where research exposes the student to active participation in the space program. Transl. by G.G.

N67-24806# RAND Corp., Santa Monica, Calif.

STEPS TOWARD A MODEL OF LINGUISTIC PERFORMANCE: A PRELIMINARY SKETCH

R. M. Schwarcz Jan. 1967 41 p refs

(Contract F 44620-67-C-0045; Proj. RAND)

(RM-5214-PR; AD-646598) CFSTI: HC $3.00/MF $0.65

The report discusses the task of formulating a model of linguistic performance and proposes an approach toward this goal that is oriented toward an embodiment of the model as a digital computer program. The methodology of current linguistic theory is criticized for several of its features that render it inapplicable to a realistic model of performance, and remedies for these deficiencies are proposed. The syntactic and conceptual data structures, inference rules, generation and understanding mechanisms, and learning mechanisms proposed for the model are all described. The learning process is formulated as a series of five stages, and the roles of nonlinguistic feedback and inductive generalization relative to these stages are described. Finally, the implications of a successful performance model for linguistic theory, linguistic applications of computers, and psychological theory are discussed. Author (TAB)

N67-24854# RAND Corp., Santa Monica, Calif.

SOME ASPECTS OF THE THEMATIC ORGANIZATION OF THE ENGLISH CLAUSE

M. A. K. Halliday Jan. 1967 28 p refs

(Contract F44620-67-C-0045)

(RM-5224-PR; AD-646663) CFSTI: HC $3.00/MF $0.65

An analysis is presented of the English clause from the point of view of its structure as a message: its thematic organization. The study is concerned with spoken English only. Recorded conversations were analyzed by rhythm, stress, and tonality, as well as by word order, to show the distinct patterns underlying a number of apparently unrelated contrasts in English grammar. The three principal systems of structuring communication are information, thematization, and identification. Each assigns a structure to the clause in terms of given--new (information), theme--non-theme (thematization), and known--unknown (identification). Information clauses distinguish between given and new phonologically, by the tone pattern. Thematic clauses distinguish between theme and rheme (non-theme) by the sequencing of elements. Identification clauses relate a known to an unknown by stress pattern. Examination of the thematic patterns of the clause not only reveals the resources available to the speaker for the structuring of information, but can also provide further insights into the better-known aspects of English syntax. Author (TAB)

N67-24892# Federal Electric Corp., Paramus, N. J.

SYSTEMS ANALYSIS PROCEDURES FOR ADP APPLICATION OF THE CORRECTIVE MAINTENANCE BURDEN PREDICTION PROCEDURES, VOLUME I Final Report

T. J. Dickerson, S. T. Smith, J. V. Mathis, and C. Butler Jun. 1966 214 p refs

(Contract Nonr-3821(00))

(PTB-66-8; AD-644911) CFSTI: HC $3.00/MF $0.65

The report presents the results of a study program to develop system analysis techniques for automatic data processing application of the Corrective Maintenance Burden Prediction Procedures. The work described represents Phase IV of a continuing program to develop maintenance manpower requirements prediction methodologies. This report describes the work performed in analyzing the prediction procedures to determine those steps that are conductive to automatic data processing, developing input data coding formats, developing appropriately coded mathematical expressions, and developing detailed system flow diagrams. The diagrams developed, which are presented in Volume II of this report, are presented in a universally understood format, and use coding techniques and notations that are readily translated into any of several of the popular computer languages. Author (TAB)

N67-24900# Pacific Missile Range, Point Mugu, Calif.

TABLES OF CONFIDENCE INTERVALS FOR BINOMIAL DISTRIBUTION OF SAMPLE SIZE 2 TO 25 INCLUSIVE, AT VARIOUS LEVELS OF CONFIDENCE

E. Neuron 17 Jul. 1959 31 p refs

(PMR-MP-59-22; AD-646815) CFSTI: HC $3.00/MF $0.65

The tables presented in the publication owe their existence to the need of evaluators of military equipment for confidence intervals on binomial distributions of small sample sizes. These tables offer sample sizes from 2 to 25 inclusive and confidence coefficients from 50% to 99% inclusive. To use the tables, it is assumed that an experiment has been conducted using a random sample of size *n*, *r* of which have exhibited a specified property. A confidence coefficient must be agreed upon; this confidence coefficient establishes the certainty which one is willing, or able, to place on the estimation of the relative size of that portion of the sampled population which exhibits the specified property. Selecting the table of the proper confidence coefficient, enter the column headed by the proper size *n* and move down the column until the row marked by *r* on the left is reached. The two numbers in that row are the boundary values of the confidence limit on the probability of the specified property appearing in any one trial. TAB

N67-25024* National Aeronautics and Space Administration, Washington, D. C.

SCIENCE POLICY PLANNING IN FRANCE. ADDRESS MADE TO THE NATIONAL ASSEMBLY, NOVEMBER 30, 1966

Alain Peyrefitte Mar. 1967 19 p Transl. into ENGLISH from the French

(NASA-TT-F-10748) CSCL 05A

A statement of France's scientific and technological policy is presented which emphasizes the necessity for such a comprehensive and coordinated research program. Policy plans are summarized, newly created agencies are discussed, and the general framework of the research program is outlined. Also included is a brief historical account of scientific progress. A.G.O.

Collections of NASA Documents

NASA is depositing its technical documents and bibliographic tools in eleven Federal Regional Technical Report Centers. Each center, located in one of the organizations listed below is prepared to furnish the general public such services as personal reference, interlibrary loans, photocopy service, and assistance in obtaining retention copies of NASA documents.

California: University of California, Berkeley
Colorado: University of Colorado, Boulder
District of Columbia: Library of Congress
Georgia: Georgia Institute of Technology, Atlanta
Illinois: The John Crerar Library, Chicago
Massachusetts: Massachusetts Institute of Technology, Cambridge
Missouri: Linda Hall Library, Kansas City
New York: Columbia University, New York
Pennsylvania: Carnegie Library of Pittsburgh
Texas: Southern Methodist University, Dallas
Washington: University of Washington, Seattle

NASA publications are currently being forwarded to the public libraries in the cities listed below:

California: Los Angeles and San Diego
Colorado: Denver
Connecticut: Hartford
Massachusetts: Boston
Michigan: Detroit
Minnesota: St. Paul and Minneapolis
Missouri: Kansas City and St. Louis
New Jersey: Trenton
New York: Brooklyn, Buffalo, Rochester and New York
Ohio: Cleveland, Cincinnati, Dayton, Toledo and Akron
Oklahoma: Oklahoma City
Tennessee: Memphis
Texas: Fort Worth and Dallas
Washington: Seattle
Wisconsin: Milwaukee

In addition, NASA regularly sends its publications to the Enoch Pratt Free Library located in Baltimore, Maryland and the Wilmington Institute Free Library, Wilmington, Delaware.

An extensive collection of NASA and NASA-sponsored scientific and technical publications available to the public for reference purposes is maintained at the Technical Information Service, American Institute of Aeronautics and Astronautics, 750 Third Avenue, New York, New York 10017.

"The aeronautical and space activities of the United States shall be conducted so as to contribute . . . to the expansion of human knowledge of phenomena in the atmosphere and space. The Administration shall provide for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof."

—NATIONAL AERONAUTICS AND SPACE ACT OF 1958

NASA SCIENTIFIC AND TECHNICAL PUBLICATIONS

TECHNICAL REPORTS: Scientific and technical information considered important, complete, and a lasting contribution to existing knowledge.

TECHNICAL NOTES: Information less broad in scope but nevertheless of importance as a contribution to existing knowledge.

TECHNICAL MEMORANDUMS: Information receiving limited distribution because of preliminary data, security classification, or other reasons.

CONTRACTOR REPORTS: Scientific and technical information generated under a NASA contract or grant and considered an important contribution to existing knowledge.

TECHNICAL TRANSLATIONS: Information published in a foreign language considered to merit NASA distribution in English.

SPECIAL PUBLICATIONS: Information derived from or of value to NASA activities. Publications include conference proceedings, monographs, data compilations, handbooks, sourcebooks, and special bibliographies.

TECHNOLOGY UTILIZATION PUBLICATIONS: Information on technology used by NASA that may be of particular interest in commercial and other non-aerospace applications. Publications include Tech Briefs, Technology Utilization Reports and Notes, and Technology Surveys.

Details on the availability of these publications may be obtained from:

SCIENTIFIC AND TECHNICAL INFORMATION DIVISION

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Washington, D.C. 20546